Honeybee mites and their control - A selected annotated bibliography

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FOOD
AND
AGRICULTURE
ORGANIZATION
OF THE
UNITED NATIONS

Honeybee mites and their control - A selected annotated bibliography

by
International Bee Research Association

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FOREWORD

This bibliography on Honeybee Mites and Their Control is an attempt to gather into one Document existing references on the principal mites which paraticize the honeybee.

FAO is publishing this annotated bibliography because of growing awareness of the importance of honeybee mites which are common to both developed and developing countries.

It is hoped that this Bulletin will assist beekeepers and researchers everywhere and provide further evidence of the continuing FAO efforts to promote beekeeping activities.

M.S.O. Nicholas
Director
Agricultural Services Division

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EXPLANATORY NOTES

This bibliography, which has 800 entries, covers the following mites that are, or may be, parasitic on honeybees; many others (not included) may sometimes be found on them. Mites marked * are known to be harmful, and some of the others may be.

Section	Mite	Known host Apis species
2	*Acarapis woodi (Rennie), Tarsonemidae	mellifera, cerana
3	*Varroa jacobsoni Oudemans, Varroidae	mellifera, cerana
4.1	Acarapis, other species	mellifera
4.2	Aceosejus sp., Aceosejidae	mellifera
4.3	*Euvarroa sinhai Delfinado & Baker, Varroidae	florea
4.4	Macrocheles spp., Macrochelidae	mellifera
4.5	Mellitiphis alvearius (Berlese), Laelapidae	mellifera
4.6	Pyemotes spp., Pyemotidae	cerana
4.71	*Tropilaelaps clareae Delfinado & Baker, Laelapidae	mellifera, cerana, dorsata
4.72	*Tropilaelaps koenigerum Delfinado-Baker & Baker, Laelapidae	dorsata

Section 2, *Acarapis woodi*, includes some of the important papers of historical interest, and selected publications on the spread and incidence of the mite, as well as those on its biology and control. *Varroa jacobsoni* (Section 3) has affected beekeeping only in the past few decades, so the historical subsection is briefer. The world spread up to 1982 has been covered by Griffiths and Bowman (1981) and Nixon (1983) - see Section 3.21 - and only publications from 1983 and later are cited here.

In each subsection, entries are arranged in alphabetical order of author, unless otherwise stated. Each entry gives the full reference, including an English translation of a title in any other language.

The information in square brackets after the reference is:

the language of the original, indicated by the code:

Arabic	Ar	Estonian	Ee	Italian	It	Serbian	Sr
Bulgarian	Bg	Finnish	Fi	Japanese	Ja	Serbo-Croat	Sh
Chinese	Ch	French	Fr	Korean	Ko	Slovak	Sk
Croat	Cr	German	De	Norwegian	No	Slovene	Sn
Czech	Cs	Greek	Gr	Polish	Pl	Spanish	Es
Danish	Da	Hebrew	He	Portuguese	Pt	Swedish	Sv
Dutch	Nl	Hungarian	Hu	Rumanian	Ro	Turkish	Tr
English	En	Indonesian	In	Russian	Ru	Ukrainian	Uk

the language(s) of any published summary, indicated by the same code (above) but with a lower case initial;

if the publication is held by the International Bee Research Association Library (indicated by B);

if IBRA holds an English translation (indicated by E and the reference number)

entry number in the journal "Apicultural Abstracts", e.g. AA100/85, which indicates entry 100 in the 1985 volume; AA101L/85 indicates that the entry is a listing and the present Bibliography includes the same information.

An annotation is given for most items, either adapted from "Apicultural Abstracts" or newly written.

Items from the XXX International Apicultural Congress in Japan, 1985, are cited from the "Program and abstracts", because the Proceedings had not been published when the Bibliography was prepared.

1 GENERAL

CHMIELEWSKI, W. (1977) Wyniki obserwacji powiązań roztoczy z owadami (Acari – Insecta). [Results of observations on associations of mites with insects.] Polskie Pismo Entomologiczne 47(1) : 59-78 [Pl, en, B, AA31/78]

In an examination of 5315 insects, including honeybees and other Apoidea, 48.7% were infested with mites; nearly 100% of the nests of social insects examined (ants, bees) were infested.

For each mite species, the associated insects and types of relationship are listed, i.e. predation, phoresy, commensalism, necrophagy or parasitism. The habitat for each insect host is also given. There are 41 insect-host relationships which are reported for the first time. This list contains English equivalents of the Polish terms used.

CROMROY, H.L.; KLOFT, W.J. (1978) Probleme der Milbenseuche der Honigbienen, betrachtet aus weltweiter Sicht. [Problems of mite diseases of the honeybee, considered from a world-wide viewpoint.] Allgemeine Deutsche Imkerzeitung 12(12) : 354-358 [De, B, AA1042/79]; see also Gaceta del Colmenar 41(8) : 412, 414, 416, 418, 420 [Es, B]

This review describing the most important mites which infest *Apis mellifera* and *A. cerana*, and their effects, includes 10 electronmicrographs.

DE JONG, D.; MORSE, R.A.; EICKWORT, G.C. (1982) Mite pests of honey bees. Annual Review of Entomology 27 : 229-252 [En, B, AA1338/82]

This review, with 175 references, describes the distribution, life cycles, diagnosis and control of *Varroa jacobsoni*, *Tropilaelaps clareae*, *Euvarroa sinhai* and *Acarapis woodi*. A table lists other mites that have been found in hives and on honeybees, although most are of no practical importance. Others, such as various Astigmata, feed on stored pollen and honey, or on their fungal contaminants, and may occasionally become serious contaminants of provisions.

DELFINADO-BAKER, M.; STYER, W.E. (1983) Mites of honey bees as seen by scanning electron microscope (SEM). American Bee Journal 123(11) : 812-813, 819 [En, B, AA247/85]

SEM photographs of *Varroa jacobsoni*, *Euvarroa sinhai*, *Tropilaelaps clareae*, *A. woodi*, and *Neocypholaelaps indica* are presented. The dipterous parasite, *Braula coeca*, is also illustrated for comparison. Details of host species, sites of infestation, and distributions of 9 species of mites found on bees or in hives are summarized in a table.

FLECHTMANN, C.H.W. (1984) Acaros associados à abelha melífera. [Mites associated with honeybees.] Pages 189-220 from "Anais do 5° Congresso Brasileiro de Apicultura, Viçosa, MG, Brasil, 23 a 27 de julho de 1980" ed. L.S. Gonçalves et al., Viçosa, MG, Brazil : Universidade Federal de Viçosa [Pt, en, B, AA623L/86]

Systematics, geographical distribution, biology, symptoms and diagnosis of *Varroa jacobsoni*, *Euvarroa sinhai*, *Tropilaelaps clareae*, *Neocypholaelaps* spp. and others.

GROBOV, O.F. (1980) [Main directions in studies on the pathology of honeybees.] Trudy Vsesoiuznogo Instituta Eksperimental'noĭ Veterinarii 51 : 117-127 [Ru, B]

Includes diseases and mites.

1 continued

MORSE, R.A. (EDITOR) (1978) Honey bee pests, predators, and diseases. Ithaca, NY, USA : Cornell University Press 430 pp. [En, B, AA1016/79]
Chapter 12 (pages 197-209) deals with mites.

SCHOUSBOE, C. (1984) Om ledsagefaunaen i danske bistader. [The attendant fauna in Danish hives.] Entomologiske Meddelelser 52 : 40-43 [Da, en, B, AA622/86]
Samples of winter debris from 432 hives in Denmark were examined. The 91 arthropod species identified are listed; 64 are insects, 21 are mites. They are classified into the following types: honeybee parasites, comb eaters, mould eaters, debris eaters, species eating debris decomposed by moulds, predators. It is suggested that 15 of the species are brought into hives or nests by the bees themselves or by ants or mice.

SNOJ, N.; OCVIRK, J. (1983) Grinje u kosnici. [Mites in beehives.] Veterinarski Glasnik 35(6) : 571-574 [Sh]

2 ACARAPIS WOODI

2.1 GENERAL

2.11 CHRONOLOGICAL LIST OF EARLY RESEARCH PAPERS (1907-1929)

IMMS, A.D. (1907) Report on a disease of bees in the Isle of Wight. Journal of the Board of Agriculture 14(3) : 129-140 [En, B]

MALDEN, W. (1909) Further report on a disease of bees in the Isle of Wight. Journal of the Board of Agriculture 15(11) : 809-825 [En, B]

GRAHAM-SMITH, G.S.; FANTHAM, H.B.; PORTER, A.; BULLAMORE, G.W.; MALDEN, W. (1912) Report on the Isle of Wight bee disease (Microsporidiosis). Journal of the Board of Agriculture 19(2) Supplement : 143 pp. [En, B]

GRAHAM-SMITH, G.S.; FANTHAM, H.B.; PORTER, A.; BULLAMORE, G.W.; MALDEN, W. (1913) Further report on the Isle of Wight bee disease (Microsporidiosis). Journal of the Board of Agriculture No. 10 Supplement : 47 pp. [En, B]

BOARD OF ARICULTURE AND FISHERIES (1913) Microsporidiosis of bees, or Isle of Wight bee disease. Leaflet, Board of Agriculture No. 253 : 8 pp. [En, B]

SIMMINS, S. (1914) A modern bee-farm and its economic management.... New and important information relating to the treatment and cure of bee-paralysis, or the Isle of Wight disease.... Heathfield, Sussex : published by the author 479 pp. rev. ed. [En, B]

ANDERSON, J. (1916) The connection of Nosema apis with Isle of Wight disease in hive bees. Proceedings of the Royal Physical Society of Edinburgh 20(1) : 16-22 [En, B]

ANDERSON, J.; RENNIE, J. (1916) Observations and experiments bearing on "Isle of Wight" disease in hive bees. Proceedings of the Royal Physical Society 20(1) : 23-61 [En, B]

KENT, CRAYFORD AND DISTRICT BEEKEEPER'S ASSOCIATION (1917) Records of the first bee restocking scheme in England. Unpublished notes [En, B]

TINSLEY, J. (1918) Preliminary report on the Isle of Wight bee disease. Bulletin of the West of Scotland Agricultural College No. 85 : 14 pp. [En, B (part)]

BOARD OF AGRICULTURE AND FISHERIES (1919) Microsporidiosis of bees, or Isle of Wight disease. Leaflet, Board of Agriculture No. 253 : 8 pp. rev. [En, B]

RENNIE, J.; HARVEY, E.J. (1919) Isle of Wight disease in hive bees. Nosema apis in hive bees. Scottish Journal of Agriculture 2(2) : 36 pp. [En, B]

RENNIE, J.; WHITE, P.B.; HARVEY, E.J. (1921) Isle of Wight disease in hive bees: (1) The etiology of the disease; (4) The organism associated with the disease - Tarsonemus woodi, n. sp. Transactions of the Royal Society of Edinburgh 52(4) : 737-754; 768-779 [En, B]

2.11 continued

Description of Tarsonemus [Acarapis] woodi; summary in Bee World 3(1) : 20 (1921).

RENNIE, J. (1921-1922) Notes on acarine disease. Bee World 2 : 144-145; 3 : 5-6, 35-36, 66-67, 95-96, 115-117, 145-146, 180-182, 204-206, 219-221, 237-239, 262-263 [En, B]

RENNIE, J. (1922) The crucial problem of British beekeeping. Benson, Oxon : Apis Club 8 pp. [En, B]

STURGES, A.M. (1922) Rational beekeeping and the prevention of acarine disease. Published by the author : 15 pp. [En, B]

ANDERSON, J. (1923) Isle of Wight disease in hive bees. Scottish Journal of Agriculture 6 : 183-191 [En, B]

RENNIE, J.; HARVEY, E.J. (1923) Mites on hive bees and on hives. Proceedings of the Royal Physical Society of Edinburgh 20(6) : 268-270 [En, B]

RENNIE, J. (1923) Acarine disease explained. Memoir, Apis Club No. 1 : 50 pp.; also Memoir, North of Scotland College of Agriculture No. 6 (1923) [En, B]

STURGES, A.M. (1923) The rational system of bee-keeping. Published by the author : 60 pages 2nd ed. [En, B]

MORGENTHALER, O. (1924) Die anzeigepflichtigen Bienen-Krankheiten. [Notifiable bee diseases.] Schweizer Archiv für Tierheilkunde (5) : 121-140 [De, B]

ARMBRUSTER, L. (1925) Die Bienenmilbe (Acarapis woodi) und der Süddeutsche Imker. [The bee mite (Acarapis woodi) and the south-German beekeeper.] Bienenpflege 47(4) : 77-85 [De, B]

ARMBRUSTER, L. (1926) Zur Acarapisfrage. [The Acarapis question.] Archiv für Bienenkunde 7(8) : 313-327 [De, B]

RENNIE, J. (1927) Acarine disease in hive bees: its cause, nature and control. Bulletin, North of Scotland College of Agriculture No. 33 : 34 pp. [En, B]

MORGENTHALER, O. (1928) Problèmes de l'acariose des abeilles. [Acarine problems.] Bulletin de la Société Romande d'Apiculture 25 : 15 pp. [Fr, B]

BORCHERT, A. (1929) Untersuchungen über das Vorkommen des Acarapis woodi bei gesunden Bienenvölkern. [Investigations on the incidence of Acarapis woodi in healthy colonies.] Bienenvater 61 : 192-196, 209-211 [De, B]

FREUDENSTEIN, K. (1929) Untersuchungsergebnisse an einem deutschen Fall von Milbenseuche. [Results of an investigation on a German case of acarine disease.] Archiv für Bienenkunde 10(7) : 209-225 [De, B]

MORGENTHALER, O. (1929) Neue Untersuchungen über die Milbenkrankheit der Bienen und ihre Bekämpfung. [New investigations of acarine disease in bees and its treatment.] Archiv für Bienenkunde 10(7) : 230-243 [De, B]

2.12 GENERAL PUBLICATIONS ON ACARINE DISEASE

ADAM, BROTHER (1968) "Isle of Wight" or acarine disease: its historical and practical aspects. Bee World 49(1) : 6-18 [En, B, AA336/69]

The losses of honeybee colonies in the British Isles from about 1904 to 1920 are reviewed in relation to infestation by the mite A. woodi, and to other diseases, management, the weather, and nectar flows. The resistance to mite damage of honeybee races introduced into England is compared. The author concludes that the "Isle of Wight" disease resulted from the introduction and spread of A. woodi into highly susceptible colonies of bees. The origin of the mite is not known. Selection of honeybee lines for resistance is proposed as the best control of the disease.

BAILEY, L. (1963) The "Isle of Wight disease": the origin and significance of the myth. Lecture to Central Association of Bee-keepers : 9 pp.; Bee World 45(1) : 32-37 (1964) [En, B, AA376L/64]

BAILEY, L. (1981) Honey bee pathology. London, UK : Academic Press x + 124 pp. + 7 pl. [En, B, AA1314/82]

This book is based to some extent on the author's "Infectious diseases of the honey bee" (1963), but it incorporates new knowledge of diseases and pathogens, some of it previously unpublished. The treatment is selective rather than comprehensive, and an elementary knowledge of biology by the reader is assumed, but the book can be read with interest by both beekeepers and insect pathologists.

Separate chapters are devoted to the pathogens of honeybee diseases - viruses, bacteria, fungi, protozoa - and to parasitic mites, insect and nematode parasites, and non-infectious disorders, e.g. hereditary faults, poisoning. Methods of treating diseases are not included in the above chapters, but are brought together in a separate one. In his final chapter the author emphasizes the need for a greater understanding of the natural histories of pathogens, particularly in relation to the dangers of introducing exotic diseases or unusual strains of pathaogens into a new area. There is a list of references and a subject index.

BORCHERT, A. (1933) Die Milbenseuche der Honigbiene. [Acarine disease of the honeybee.] Flugblatt, Biologische Reichsanstalt für Land- und Forstwirtschaft No. 125 : 4 pages [De, B]

BULLETIN APICOLE D'INFORMATION (1960) Bibliographie acariose. [Bibliography on acarine disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 3(1) : 73-76 [Fr, B, AA291L/62]

Gives 117 references.

KAESER, W. (1958) Zur Milbenseuche. [Acarine disease.] Pages 59-60 from "Proceedings of the XVII International Beekeeping Congress, Bologna and Rome, 1958" [De, En, Fr, It, B, AA429/58]

The whole problem of acarine disease and its control is discussed. It is emphasized that beekeeping methods are closely linked with the incidence of the disease and with its control. Biological control methods are thus better than chemical methods; if the latter are used, fumigation is more effective than evaporation.

KAESER, W. (1984) Die Milbenseuche (Acariose). [Acarine disease.] Pages 173-211 from "Krankheiten der Biene" ed. by E. Zander and F.K. Böttcher, Stuttgart : Verlag Eugen Ulmer [De, B]

2.12 continued

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD (1972) Acarine. Advisory Leaflet, Ministry of Agriculture, Fisheries and Food No. 330 : 6 pp. [En, B, AA441L/74]

MORGENTHALER, O. (1937) Milben-Sorgen. [Acarine troubles.] Schweizerische Bienenzeitung 60(3) : 144-146 [De, B]

MORGENTHALER, O. (1964) Zur Geschichte und Naturgeschichte der Bienenmilbe Acarapis. [On the history and natural history of the Acarapis mite.] Bienenpflege (4) : 71-76 [De, E730, B, AA167L/65]
Reasons are given for rejecting Bailey's view that acarine disease is comparatively harmless.

SVOBODA, J. (1958) [Acarine disease of bees.] Vestnik Sel'sko-khozyaistvennoĭ Nȧuki 30(9) : 99-106 [Ru, en, de, B]

2.13 GENERAL PUBLICATIONS ON ACARAPIS WOODI

ATWAL, A.S. (1971) Acarine disease problem of the Indian honey bee, Apis indica F. American Bee Journal 111 : 134-135; 186-187 [En, B, AA1016/72]
A. woodi mites were found infesting the large thoracic tracheae of Apis cerana from Katrain (Western Himalayas) in 1957, and have since been found elsewhere in India. Healthy young (marked) bees became infested within 2 days after their release in a diseased colony. Only female mites, apparently already mated, entered a bee's tracheae, and they soon began egg laying. Maximum infestations occurred when the bees were 4-5 wk old. Measurements of the stages of the male and female mites are given. An infested bee's tracheae became completely blackened within 1 wk. External signs of infestation are described. In all three localities studied, with different climatic conditions, infestations were maximal in winter (Nov.-Jan.), and minimal in May-June. In summer, 4-5 weekly fumigations with Folbex (chlorobenzilate smoke) proved adequate for control of the mites, or 6-7 in spring.

BAILEY, L. (1985) Acarapis woodi: a modern appraisal. Bee World 66(3) : 99-104 IBRA Reprint M116 [En, B, AA241/86]
The life cycle of A. woodi, and factors affecting the spread of infestations are outlined. The mite was considered an important pest in the UK in the early 1920s, but its incidence has declined steadily since 1925, coincident with a fall in the total number of honeybee colonies. A similar association between colony numbers and cases of paralysis indicates that a relationship exists between colony density and contagiously transmitted pathogens. The author suggests that a critical factor in this relationship is the relative availability of forage, and that the number of colonies in the UK today is roughly in equilibrium with the available nectar, whereas in the past the number of colonies probably exceeded this equilibrium density.
The density of A. woodi in the USA is described and it is suggested that the heaviest infestations will occur in regions where the number of colonies exceeds the optimum density for the locality. The treatment of infestations is also discussed.

BORCHERT, A. (1932) Untersuchungen an der Acarapismilbe. [Investigations on Acarapis mite.] Zeitschrift für Parasitenkunde 4(2) : 331-368 [De, B]

2.13 continued

DELFINADO-BAKER, M. (1984) An explanation of the term "acarine mite" used in beekeeping. American Bee Journal 124(10) : 697 [En, B, AA709L/85]
The common name "tracheal mite" or "honeybee tracheal mite" is proposed for *A. woodi*.

FREUDENSTEIN, K. (1933) Zur Frage der Identität der harmlos und seuchenerregend in Bienenstöcken vorkommenden "Bienenmilben" (*Acarapis woodi*, Rennie und *Acarapis externus*, Morgenthaler). [On the question of the identity of the harmless and pathogenic mites found in bee hives (*Acarapis woodi* Rennie & *Acarapis externus* Morgenthaler).] Pages 34-57 from "Festschrift zum 60. Geburtstag von Prof. Zander", Leipzig, Germany : Liedloff, Loth und Michaelis [De, B]
Reviewed in Bee World 14(10) : 115-116 (1933)

GIORDANI, G. (1977) Facts about acarine mites. Pages 459-467 from "Proceedings of the XXVIth International Apicultural Congress, Adelaide", Bucharest, Romania : Apimondia Publishing House [En, B, AA661L/79]

JEFFREE, E.P. (1955) The Beekeeping Research Department of Aberdeen. Scottish Beekeeper 31(6) : 112-113 [En, B, AA190/57]
The discovery of the acarine mite was made at Aberdeen by J. Rennie, P.B. White and Miss E.J. Harvey in 1921; further research on the acarine mite and bee diseases was carried on by G.D. Morison. The Bee Research Department was formed in 1947, and the present staff of three are studying in particular long-term causes and effects in beekeeping, and the relations between temperature and acarine disease.

MAREK, J. (1984) Nový přístup k roztočíkové nákaze. [A new approach to *Acarapis* infestation.] Veterinářství 34(10) : 470-473 [Cs, B]

MORGENTHALER, O. (1937) Der Milbenbefall der Honigbiene, ein neu entstandener Parasitismus? [The acarine disease of the honeybee, a case of a newly developed parasitism?] Mitteilungen der Naturforschenden Gesellschaft in Bern : 133-147 [De, B]

MORGENTHALER, O. (1964) Beitrag zur Diskussion um die Bienenmilbe. [Contribution to the discussion on the acarine mite.] Imkerfreund 19(9) : 333-336 [De, B, AA346L/65]

2.2 SPREAD AND WORLD DISTRIBUTION

2.21 HISTORICAL AND GENERAL

ADLAKHA, R.L. (1976) Acarine disease of adult honey bees in India. American Bee Journal 116(7) : 324, 344 [En, B, AA838/77]

Acarine disease was first reported in India in 1956. In a survey of the whole of India during 1962-1967 it was found to be present only in the northern states, and this is still true. It is found only in *Apis cerana*, and in some *Apis mellifera* which were infected from native bees (they were disease-free when imported). It has not been found in *Apis dorsata* or *Apis florea*.

The following were tested as fumigants against the mite: (a) Folbex; (b) methyl salicylate (ineffective); (c) menthol (ineffective); (d) a mixture of nitrobenzene, methyl salicylate and petrol, which was effective, but induced severe and uncontrollable robbing, and damaged brood. The usual treatment with Folbex during the active period is thus recommended: If treatment is necessary during a dearth period, a push-in cage should be used to isolate the queen, which should be released 1-7 days after treatment. In the conditions of the low hills of India, April is the best time for prophylactic fumigation.

AMERICAN BEE JOURNAL (1984) *Acarapis woodi* found in Louisiana, other states negative. American Bee Journal 124(10) : 697 [En, B, AA934L/85]

Report of an infestation at a single apiary in New Iberia, LA; the mites probably came with bees purchased in Texas.

ATWAL, A.S. (1967) Acarine disease problem of honey bees in the Punjab. Technical Report, College of Agriculture, Punjab Agricultural University, Ludhiana : 39 pp. [En, B, AA161/70]

Apiary colonies of *Apis cerana* and of *Apis mellifera* (introduced), and wild colonies of *Apis dorsata* and *Apis florea*, in various Indian states were surveyed for the presence of *A. woodi*. The results are presented in section 1 of the report. None of the *Apis dorsata* and *Apis florea* bees examined were infested. An account of the symptomatic behaviour of infested *Apis indica* bees is given in section 2, and section 3 describes the seasonal incidence of acarine disease in *Apis indica* apiaries at different altitudes in Punjab. Biometric and life-history studies of the mite are described in section 4.

Interspecific infestations were attempted (section 5), using diseased *Apis indica* bees to infect *Apis mellifera*, *Apis dorsata* and *Apis florea*. Neither *Apis dorsata* nor *Apis florea* bees became infested. Robbing among *Apis indica* colonies, and robbing of *Apis indica* colonies by *Apis mellifera*, may lead to rapid spreading of disease in these two species. An investigation of control measures (section 6) indicated that 4-5 weekly fumigations with a Folbex strip in summer, and 6-7 fumigations in early spring, gave adequate control.

BAILEY, L.; PERRY, J.N. (1982) The diminished incidence of *Acarapis woodi* (Rennie) (Acari: Tarsonemidae) in honey bees, *Apis mellifera* L. (Hymenoptera: Apidae), in Britain. Bulletin of Entomological Research 72 : 655-662 [En, B, AA1265/83]

Investigations showed that there is a highly significant linear relationship between percentage of honeybee colonies detectably infested with *Acarapis woodi* and the total number of colonies in England and Wales. A decline of infestation since 1947 corresponds to a decrease recorded in

2.21 continued

the known number of colonies. It is suggested that the decrease has allowed the foraging activity of the remaining colonies to increase, so lessening the contact between old infested bees and young susceptible individuals sufficiently to hinder the spread and multiplication of mites within colonies.

BANKS, A.W.; KORTHALS, A. (1961) Mites of the genus *Acarapis* on bees in South Australia. Australian Veterinary Journal 37(10) : 397-398 [En, B, AA852L/63]

No evidence was found of tracheal mites on honeybees.

BARBOSA DA SILVA, R.M. (1977) Ocorrência de *Acarapis woodi* Rennie em Pindamonhangaba, estado de São Paulo. [Occurrence of *Acarapis woodi* in Pindamonhangaba, State of São Paulo.] Pages 207-209 from "Anais do 4° Congresso Brasileiro de Apicultura, 1976", Curitiba, PR, Brazil [Pt, en, B, AA1284L/78]

BENOIT, P.L.G. (1959) The occurrence of the acarine mite *Acarapis woodi* in the honeybee in the Belgian Congo. Bee World 40(6) : 156 [En, B, AA348/60]

Five out of 167 specimens of *Apis mellifera adansoni* from different parts of the Belgian Congo were infested with *A. woodi* in the tracheae, the place of origin of the bees being unknown.

BRIMBLECOMBE, A.R.; ROFF, C. (1961) Distribution of *Acarapis woodi* (Rennie). Nature, UK 190(4775) : 561 [En, B, AA482L/62]

Acarine mites (referred to as *A. woodi*) were found on worker honeybees introduced from the USA, New Zealand and Italy, but were identified as *A. externus*.

CLARK, W.H.; CLARK, M.H. (1986) First record of *Acarapis woodi* Rennie in the honey bee from Baja California, México. American Bee Journal 126(2) : 123-124 [En, B]

The mite was found in one of three wild nests at an infestation level of 3.6%. The occurrence may preclude Baja California as a mite-free honeybee queen production area.

CRANE, E. (1968) Mites infesting honeybees in Asia. Bee World 49(3) : 113-114 [En, B, AA187/71]

A report is given of recent records of mites infesting *Apis mellifera*, *Apis cerana* and *Apis dorsata* in Asia. The species of mites recorded are *Varroa jacobsoni*, *Tropilaelaps clareae*, *Aceosejus* sp., *Neocypholaelaps indica* and *Tarsonemus indoapis*. No mites have yet been observed on *Apis florea*.

DELFINADO-BAKER, M.; SHIMANUKI, H. [1981?] Pests not known to occur in the United States or of limited distribution, No. 17: honey bee mite. Publication, United States Department of Agriculture : 8 pp. [En, B]

DELFINADO-BAKER, M.; KNOX, D. (1982) Infestations of *Apis cerana indica* colonies by *Acarapis woodi* and *Varroa jacobsoni*. American Bee Journal 122(8) : 592 [En, B, AA817/83]

Samples of bees and brood collected from 2 apiaries in Pakistan [specific locality not known] in May 1982 were examined. Female mites of *V. jacobsoni* were found in the brood cells. *A. woodi* was identified in the tracheae of adult bees. This mite was also identified in a sample of bees collected at Rawalpindi. This is the first report of acarine disease in Pakistan.

2.21 continued

DELFINADO-BAKER, M. (1985) An acarologist's view: the spread of the tracheal mite of honey bees in the United States. American Bee Journal 125(10) : 689-690 [En, B]

It is concluded that the rapid spread of the tracheal mite to 17 states during a 13-month period is the result of migratory beekeeping and the distribution of package bees.

ECKERT, J.E. (1961) Observations on the Acarapis mites of honey bees. American Bee Journal 101(5) : 183-188 [En, B, AA177/62]

Specimens of A. dorsalis and A. externus were compared with A. woodi. Measurements are given for all stages, and the occurrence of different stages of external mites on honeybees of various ages is reported.

ECKERT, J.E. (1961) Acarapis mites of the honey bee, Apis mellifera L. Journal of Insect Pathology 3(4) : 409-425 [En, B, AA167/64]

Measurements of morphological characters of A. woodi are compared with those of A. dorsalis and A. externus, which are widespread in N. America. Development periods for external mites are egg 4 days, larva 4, pupa 1-2.

ELISSAIOU, M. (1965) [First occurrence of acarine disease in Greece.] Melissokomike Ellas 15(169) : 24 [Gr, B]

A description of the first appearance in Greece of acarine disease, diagnosed at the Agricultural School of Athens by X. Nikopontos. The mites were said to have been discovered on queens imported from Canada.

FLECHTMANN, C.H.W.; AMARAL, E.; SANTOS, F.D. DOS (1977) Ocorrência da acariose no estado de São Paulo. [Occurrence of acarine disease in the state of São Paulo.] Pages 197-198 from "Anais do 4° Congresso Brasileiro de Apicultura, 1976", Curitiba, PR, Brazil [Pt, en, B, AA1283L/78]

FLECHTMANN, C.H.W. (1977) A abelha "Africanizada" e a disseminação do Acarapis woodi (Rennie) no Brasil. [The Africanized honeybee and the dissemination of Acarapis woodi in Brazil.] Anais da Sociédade Entomológica do Brasil 6(1) : 130-131 [Pt, B, AA947L/80]

FOOTE, H.L. (1959) Acarine mite reported in US. Gleanings in Bee Culture 87(11) : 666-667 [En, B, AA76/61]

A queen bee and attendants from Northern California were found on arrival in Australia to be infected with mites which were reported to be Acarapis woodi (Rennie); 571 samples (about 17000 bees) from the nuclei and colonies concerned were examined for acarine disease, with negative results. This indicated that the mites in question were A. woodi externus and not A. woodi woodi.

GONZÁLEZ, A.R.; MARTINEZ, J.M.; CÈSPEDES, R.; SÁNCHEZ, U. (1985) Acariasis in Apis mellifera L. in Cuba. Assessment of a technique. Page 85 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

A total of 4500 bee samples from apiaries in different areas of Cuba were examined (a) by careful inspection at the apiaries, and (b) by direct microscopic observation in the laboratory. The compression method was used to examine tracheae for the presence of A. woodi; this was an accurate and fast method. All samples gave negative results, and all the tracheae observed were translucent and healthy.

Regular investigations should be carried out as part of the prevention programme against this disease.

2.21 continued

JEFFREE, E.P. (1959) The world distribution of acarine disease of honeybees and its probable dependence on meteorological factors. Bee World 40(1) : 4-15 [En, B, AA65/61]

Reference is made to a progressive series of climatic types which apparently govern biological distributions. Two maps have been drawn up on the supposition that the distribution of acarine disease corresponds nearly with one of this series. Map 1 is based on January and July temperatures, and Map 2 on latitudes and winter rainfall. The known world distribution of the disease has been drawn up from the literature and is shown on both maps. A table lists countries in which acarine disease is present and those in which, on this basis, it may be expected.

KAESER, W. (1954) Aus der Arbeit des Freiburger Instituts. [Some of the work of the Freiburg Institute.] Südwestdeutscher Imker 6(5) : 136-138 [De, B, AA111/57]

Work on the treatment of acarine and Nosema disease is described. Acarine-infested colonies treated in 1950 and 1951 by removing the brood were still free from the disease in 1954; 63% of the apiaries treated with Delacan were also free from acarine mites.

In 1954 acarine disease was confirmed in many places in N. and S. Baden; this is considered to be due to the poor 1953 season; it kept bees confined for long periods, and prolonged the lives of foragers, and so encouraged the spread of the mites.

KATZENELSON, M. (1968) ¿Debe preocuparnos la acariosis de la abeja? [Should we be worried about acarine disease?] Gaceta del Colmenar 30(11) : 306-308 [Es, B, AA546/69]

Examination of 200 000 bees between 1964 and 1968 led to the conclusion that there is no serious infestation with A. woodi in Argentina. Between 0 and 5% of colonies were infected. The mite was found in 36.6% and 16.6% respectively of the bees of two colonies that were being robbed out.

KOCH, H. (1956) Le problème de l'acariose en Belgique. [The problem of acarine disease in Belgium.] Belgique Apicole 20(1/2) : 14-22 [Fr, B, AA98/58]

Notification of acarine disease is compulsory in Belgium, and the present law requires that the hive as well as its contents shall be destroyed. This is so in spite of the established fact that infection can only be transmitted from live bees. As a result of this law, beekeepers only report the disease if the bees have died; they are then glad to get compensation for the destruction of the hives. Another drawback is that the size of the sample inspected is too small to show up any but serious infections.

A map of Belgium (admittedly incomplete) shows the distribution of acarine disease in 1954 and 1955. A map of Brabant, also incomplete, shows the progress made between 1949 and 1955. An introductory section deals with the treatment of acarine disease.

KOCH, H. (1959) L'évolution de l'acariose en Belgique: influence de l'utilisation de la méthode PK. [The course of acarine disease in Belgium: effect of the use of PK treatment.] Belgique Apicole 23(1/2) : 8-15 [Fr, B, AA127/60]

Distribution of the disease in 1956-1958 is compared with that in 1954-1957. Eight treatments with PK during the active season has reduced infestation.

2.21 continued

KSHIRSAGAR, K.K. (1966) A review of work on acarine disease of honeybees. 1. History and distribution. Indian Bee Journal 28(2) : 79-84 [En, B, AA451/70]

In India, large-scale colony losses were not reported before 1945, and only in 1956 was infestation with A. woodi established as a cause. A. woodi has been found [presumably in Apis cerana] in widely separated parts of India; the Kulu and Kangra valleys are the most heavily infested areas, and colony losses have been up to 50-60%. Infestation is said to be most severe in areas where honeybee colonies have been imported from other countris. A programme of selection for resistance or immunity to acarine disease has been undertaken at the Regional Bee Research Centre at Kangra.

KSHIRAGAR, K.K. (1982) Current incidence of honeybee diseases and parasites in India. Bee World 63(4) : 162-164 [En, B, AA958/83]

This note gives more detailed information for India and makes some corrections to Nixon's 1982 preliminary world maps. A map shows the incidence of the following diseases in India: sac brood, acarine, EFB, nosema and viral diseases. Other diseases are thought to be absent. External mites such as Tropilaelaps on introduced Apis mellifera and Varroa jacobsoni on A. cerana and A. dorsata have been reported from many parts of the country, but Varroa is not common. Braula, though present, is uncommon.

LAERE, O. VAN; GILLARD, A. (1954) Onderzoekingen over de verspreiding en de bestrijding van de mijtziekte der honingbij. [Distribution and control of acarine disease [in Belgium].] Mededelingen van de Landbouwhogeschool en de Opzoekingsstations van de Staat te Gent 19(4) : 603-636 [Ne, en, de, fr, B, AA88/56]

The history and present world distribution of acarine disease is described. Four maps show in detail the distribution in Belgium from 1949 to 1952; a list of localities (with dates) is also given. Thirteen chemical treatments are described; it is stated that PK and Delacan gave "far better results ... than any other method"; 95% of the mites were killed by PK which is considered the best method. Frow treatment rarely killed the mites without causing damage to the bee population.

LEHNERT, T.; MICHAEL, A.S.; LEVIN, M.D. (1974) Disease survey of South American Africanized bees. American Bee Journal 114(9) : 338 [En, B, AA809L/75]

Nosema disease was present in 54% of samples from Brazil; acarine in 12%.

MORGENTHALER, O. (1959) Meine Erfahrungen mit der Milbenkrankheit. [My experiences with acarine disease.] Deutsche Bienenwirtschaft 10(5) : 87-90 [De, B, AA161/60]

Discussion of various results and views on A. woodi.

MORGENTHALER, O. (1960) Neuere Arbeiten über das Vorkommen der Bienenmilbe Acarapis. [Recent work on the occurrence of the mite Acarapis.] Deutsche Bienenwirtschaft 11(1) : 5-7 [De, B, AA109/61]

This is a review of the present world situation, in the light of the recent finding of external acarine mites in North America, and imported thence into Australia, of the tracheal mite in India and in the Congo. The author regards the original source of the tracheal mite as an exciting problem which international co-operation may help to solve.

2.21 continued

MORISON, G.D.; OTHERS (1956) Acarine and Nosema diseases of honeybees in Britain, 1925-47. Bulletin of Entomological Research 46(4) : 753-759 [En, B, AA325/57]

Between 1925 and 1947, 9929 samples of bees were examined for acarine and Nosema diseases. The results indicate a significant difference between the incidence of acarine disease (not not Nosema) in England and Scotland. There was a gradual but significant decrease of both diseases over the 23 years.

The incidence of acarine was lowest in April, May and June, whereas that of Nosema was highest then. The relation between acarine disease and temperature is discussed, and also the seasonal variations of acarine, Nosema and 'Isle of Wight' diseases, the comparative validity of sampling methods used by different authors, their methods (especially Morgenthaler's) of calculating the incidence of disease in each month, and finally the reasons underlying the seasonal variations, which are shown to be similar in Scotland, England, Switzerland and Tula (USSR).

NASCIMENTO, C.B. (1970) Pesquisa de endo e ecto-parasitos de Apis mellifera. [Investigation on internal and external parasites of honeybees [in Brazil].] Pages 199-207 from "1 Congresso Brasileiro de Apicultura", Florianópolis, SC, Brazil DEMA, SC and ACA [Pt, en, B, AA654/74]

Infestation of honeybees with A. woodi is reported for the first time in Brazil. Altogether 2227 bees from the States of Rio de Janeiro, Santa Catarina, and Rio Grande do Sul, were dissected.

NASCIMENTO, C.B. (1971) La acariosis en Brasil. [Acarine disease in Brazil.] Ciencia y Abejas 1(1) : 35-39 [Es, en, B, AA399L/73]

Tracheae of 25 out of 775 bees examined contained A. woodi.

NASCIMENTO, C.B.; MELLO, R.P. DE; SANTOS, M.W. DOS; NASCIMENTO, R.V. DO; SOUZA, D.J. DE (1971) Ocorrência de acariose em Apis mellifera no Brazil. [Occurrence of acarine disease in Apis mellifera in Brazil.] Pesquisa Agropecuaria Brasileira, Seção Veterinária 6 : 57-60 [Pt, en, B, AA398/73]

A. woodi was detected for the first time in honeybees in Brazil. Of 830 bees from one region, 25 contained these parasites. The most heavily infested tracheae contained 13 A. woodi, including larvae, nymphs and adults.

NICOLOPOULOS, C.N. (1965) [On the detection of bee acariasis for the first time in Greece.] Bulletin, Agricultural Bank of Greece No. 142 : 24-27 [Gr, en, B]

NIXON, M. (1982) Preliminary world maps of honeybee diseases and parasites. Bee World 63(1) : 23-42 IBRA Reprint M108 [En, B, AA1315/82]

Maps show countries in which the following diseases are present, suspected present, or reported absent: AFB, EFB, sac brood, chalk brood, nosema disease, amoeba disease, acarine disease, and bee lice (Braula spp.). In addition, there are 5 tables giving fuller information on the 8 diseases and parasites, including data on countries and islands too small to be shown on the maps, and the source of reference from which each record was taken, according to a list of 172 numbered references.

RAMIREZ GOMEZ, C. (1949) Nota sobre hallazgo de Acarapis woodi en la isla de Mallorca. [Discovery of Acarapis woodi on the island of Mallorca.] Bolétin de la R. Sociedad Española de la Historia Natural 47 : 611-618 [Es, B, AA209/57]

2.21 continued

The discovery of acarine mites infesting bees in this Spanish island was made in 1946. The paper gives information about this occurrence, and also anatomical and other details about the mites, as determined by the author and others.

RASHAD, S.E.; EWEIS, M.A.; NOUR, M.E. (198a5) Studies on the infestation of honeybees (Apis mellifera) by Acarapis woodi in Egypt. Pages 152-156 from "Proceedings of the Third International Conference on Apiculture in Tropical Climates, Nairobi, Kenya, 5-9 November 1984", London, UK : International Bee Research Association [En, B, AA240/86]

Infestation of honeybee colonies by A. woodi was recorded for the first time in Egypt in 1977. In a survey (1980/1981) of 37 modern apiaries, the mite was found in 34; in apiaries in the north, between 36 and 87% of workers in an apiary were infested, but in some samples from the south infestation was 100%. Mortality of infested colonies ranged from 4 to 33%. Mites were also found in 10 of the 12 apiaries of traditional hives sampled (20-100% infestation); 50-100% of colonies had died. Stacking the mud pipe hives together contributes to the spread of the mites. In two monitored colonies, infestation was highest in January-March (above 70%), decreasing to 4% in May; no infestation was recorded in summer and early autumn, but the mites reappeared in October (5.3%). The incubation period for eggs and the larval period each lasted 4-5 days, and the nymphal stage 3-4 days. Thus, the mite's life cycle could be completed in 11-14 days. Fumigation with Folbex strips once per week over a period of 8 weeks resulted in complete recovery of infested colonies. Treatment with Akar 50% or Kelthane was not effective.

REYES ORDAZ, F.J. (1984) La acariosis de la abeja doméstica Apis mellifera, Linneo) causado por Acarapis woodi, Rennie (Acari: Tarsonemidae) en la zona de Córdoba, Ver. [Acarine disease of honeybees (Apis mellifera) caused by Acarapis woodi in the Córdoba region, Veracruz [Mexico].] Tesis Licenciado en Biologia, Universidad Veracruzana, Mexico : iv + 50 pp. [Es, en, B, AA1315/85]

In a short survey in Córdoba, Veracruz, Mexico, A. woodi was found in all 46 apiaries investigated (1008 colonies): the proportion of colonies affected varied from 4% to 80%. The siting of hives (in full shade, half-shade, or in full sun) had no effect on the severity of infestation.

ROSSI, C.O.; CORNEJO, L.G.; DAVILA, M. (1970) Informes tecnicos sobre nosemosis. [Technical information on nosema disease.] Informe Tecnico, Provincia de Buenos Aires, Ministerio de Asuntos Agrarios, Dirección de Agricultura No. 2 : 28 pp. [Es, B, AA445/74]

Includes a map showing the distribution of nosema and acarine diseases in the apiaries of one area near Buenos Aires.

SCHICHA, E.; LOUDON, B. (1980) The first quarantine interception of Isle of Wight disease in New South Wales. Australasian Beekeeper 82(2) : 31-33 [En, B, AA994L/81]

A. woodi was found in 1 of 16 workers escorting 2 queens imported from Bologna, Italy.

SCHNEIDER, H. (1959) Die Milbenbekämpfung mit Folbex. [Treatment of acarine disease with Folbex.] Schweizerische Bienen-Zeitung 82 : 105-111, 156-162, 198-205 [De, B, AA121/62]

2.21 continued

Full details are given of the method used for treatment of colonies with Folbex and of experimental results obtained. Maps show the distribution of acarine disease in Switzerland in 1954, 1958 and 1959; a fourth map shows the areas treated in 1953-1958, 8 times with Folbex, or 8 times with PK, or once (1958) with Frow treatment. From the results it is concluded that Folbex can be used successfully, but only under exact observance of the right conditions. Acarine disease could be eliminated from an area, but only if all the apiaries were treated, because of the certainty of reinfection.

SINGH, S.; ADLAKHA, R.L. (1958) Acarine disease of adult honey-bees. Indian Bee Journal 20(6) : 64-78 [En, B, AA454/61]
In addition to describing the diagnosis and treatment of acarine disease, the authors discuss the distribution of the disease in India, and report results for the Punjab. [Deals with Apis cerana.]

SINGH, S.; ADLAKHA, R.L. (1960) Survey of acarine disease of adult honeybees in Simla Hills. Indian Bee Journal 22(1/3) : 3-6 [B, AA120/62]
Samples of bees taken from wall and movable-frame hives showed widespread infection in 10% of the colonies. [Deals with Apis cerana.]

VOGELSANG, E.G.; RODIL C., T. (1957) Acariosis de las abejas (Apis mellifica) por Acarapis woodi Rennie. [Acarine disease of bees caused by Acarapis woodi Rennie.] Revista de Medicina Veterinaria y Parasitologia 16(1/14) : 79-80 [Es, B, AA396L/63]
Reports current incidence in Venezuela and quotes earlier incidence in Uruguay.

WILSON, W.T.; NUNAMAKER, R.A. (1982) The infestation of honey bees in Mexico with Acarapis woodi. American Bee Journal 122(7) : 503-505, 508 [En, B, AA601/83]
Honeybees collected from an apiary near Guadalajara (state of Jalisco), Mexico, were infested with A. woodi. In 3 of 4 modern hives 40-70% of adult workers were infested, and in primitive hives, 30%.

WILSON, W.T.; RHODES, H.A.; NUNAMAKER, R.A.; STONER, A. (1985) The possible consequences of finding Acarapis woodi adults in honey bees from Venezuela, South America. American Bee Journal 125(9) : 640-641 [En, B]
A. woodi adults were found in the tracheal tubes of an adult worker honeybee from Venezuela. This finding confirms the presence of the mite there. The tracheal mite and other parasites may have been responsible for some of the honeybee losses that have, in recent years, been attributed to Africanization in South and Central America.

ZMARLICKI, C. (1984) Beekeeping with Apis mellifera and mite control in Burma. Pages 45-49 from "Proceedings of the Expert Consultation on Beekeeping with Apis mellifera in Tropical and Sub-tropical Asia, Bangkok/Chiang Mai, Thailand, 9-14 April 1984", Rome, Italy : FAO [En, B]
V. jacobsoni and T. clareae were present in every Apis mellifera colony examined. Mature colonies of Apis cerana examined were heavily infested with V. jacobsoni; the absconding rate is high. A combined treatment used on some Apis mellifera colonies was effective: first, the queen was caged for 21 days so that there was a break in brood rearing, and then colonies were smoked with fumes of phenothiazine + potassium nitrate.

2.22 EFFECTS OF CLIMATE

ALEKSEENKO, F.M. (1973) [Effectiveness of chemical treatments during acarine disease of honeybees.] Veterinariya, Moscow, USSR No. 7 : 59-62 [Ru, B, AA243/78]

Colonies infested with A. woodi were treated with various acaricides including Micasin (containing chlorphensulphide, bis(4-chlorophenyl) disulphide, Neotran), Milbex (containing chlorphensulphide, chlorphenethol), Folbex (containing chlorobenzilate) and Tedion (tetradifon). The best results were obtained with Milbex and Micasin as fumigants in doses of 0.1-2.0 g/hive, repeated 7-10 times at intervals of 2, 3 and 5 days. When treatments were carried out in April-May, 80-100% of colonies were freed from mites.

In the districts of the Ukraine where tests were made, the disease was more prevalent in damp regions near water or marsh than in the drier regions to the south. Meteorological conditions during April-July were related to the severity of infestation; this increased with rain and low temperatures. Details are given of a formula for forecasting infestations.

CZERWIŃSKI, M.; JANUSZEWSKI, J.; NIEMCZUK, R. (1963) Analiza i ocena wpływu środowiska geograficznego dolnego slaska na rozprzestrzenianie sie choroby roztoczowej pszcźoł. [Analysis and assessment of the influence of the geographical environment of lower Silesia on the spread of acarine disease. Zycie Wetarynaryjne (3) : 19-24 [Pl, B, AA352/65]

A definite correlation was found between outbreaks of acarine disease and the configuration of the ground. The disease occurred most often in mountain valleys, near rivers, and where the water table was near the surface. It was apparently not influenced by the absolute amount of rainfall or absolute height. The authors discuss the micro-climatological implications of these findings and suggest that the likely direct physical cause of concentration of disease in hollows is the high relative humidity and low temperature; these result in large heat losses and consequent weakening of colonies.

JEFFREE, E.P. (1955) Acarine disease of the honeybee and temperature. Nature, UK 175 : 91 [En, B, AA119/56]

Acarine disease occurs in those areas of Europe that are enclosed by the January isotherms of -3°C and +54°, and the July isotherms 11° and 19°. Other significant negative and positive correlations between the incidence of the disease in Britain and temperatures have been found.

It is suggested that the mites have less chance to mature and migrate in hot weather, and that infected colonies are killed in areas with winter temperatures below the low winter limit. Areas with temperatures below the low summer limit are not suitable for bees; the upper winter limit is probably directly related to the upper summer limit.

JEFFREE, E.P. (1959) The world distribution of acarine disease of honeybees and its probable dependence on meteorological factors.

The full entry, with annotation, is in 2.21.

NIEMCZUK, R. (1970) Climatic treament in acarapidosis apium. Acta Parasitologica Polonica 18(48) : 551-554 [En, pl, B, AA760/72]

In Lower Silesia acarine disease occurred mainly in the mountain and river valleys, up to 600 m above sea level. At higher altitudes apiaries were largely free of the disease. Three infested colonies were left untreated in an isolated area at 800 m; during 3 years there was a continuous decrease in the percentage of bees infested: from 98, 96 and 97% to 0, 0, and 2%. It is thought that air temperature and humidity may be the important factors.

SAMYSHKINA, V.S. (1966) [Epidemiology of acarine disease of honeybees in the USSR.] Trudy Nauchno-issledovatel'skogo Instituta Pchelovodstva : 423-433 [Ru, en, B, AA545/69]

Data from regional beekeeping centres, beekeepers and laboratories, and microscopic investigations of bee samples, indicated the presence of acarine disease in 10 regions of the Russian Soviet Federated Socialist Republic (RSFSR), 3 regions of the Ukrainian SSR, and in the Estonian and Latvian SSR. Attempts to correlate the data with the climatic characteristics of the different zones were not successful. It is concluded that the effects of weather conditions on the spread of acarine disease are weakened by the microclimate established in the honeybee colony.

2.3 BIOLOGY OF ACARAPIS WOODI

2.31 GENERAL

ATWAL, A.S. (1971) Acarine disease problem of the Indian honey bee, Apis indica F. American Bee Journal 111 : 134-135; 186-187 [En, B, AA1016/72]
The full entry, with annotation, is in 2.13.

ECKERT, J.E. (1961) Observations on the Acarapis mites of honey bees.
The full entry, with annotation, is in 2.21.

ECKERT, J.E. (1961) Acarapis mites of the honey bee, Apis mellifera L.
The full entry, with annotation, is in 2.21.

ÖRÖSI-PÁL, Z. (1934) Bau, Entwicklung und Lebensweise des Bienenparasiten Acarapis woodi (Acarina). [Structure, development and habits of bee parasite Acarapis woodi.] Zeitschrift für Parasitenkunde 7(2) : 233-267 [De, B]

2.32 ANATOMY AND MORPHOLOGY

MICHAEL, A.S. (1962) Morphological characters of the honey bee mites. Bulletin Apicole d'Information et de Documentation Scientifique et Technique 5(1) : 21-28 [En, Fr, de, es, B, AA366/65]
Acarapis dorsalis is characterized by an apodeme which extends to the full length of the propodosoma, and a deep indentation of the coxal plate. In two other species the apodeme is only 2/3 the length of the propodosoma: A. woodi has a coxal plate with a shallow indentation and tarsal joints <10 μ; A. externus has a truncated coxal plate and tarsal joints >10 μ.

SACHS, H. (1951) Zur Morphologie von Acarapis. (1) Bau und Funktion der Mundwerkzeuge der Tracheenmilbe Acarapis woodi Rennie, 1921. [On the morphology of Acarapis. (1) Structure and function of the mouthparts of the tracheal mite.] Zeitschrift für Bienenforschung 1(6) : 103-112; shortened translation in Bee World 33(12) : 201-209 (1952) [De, B, AA182/53]
The two stylets, the stylet guides, the stylet levers and the tube surrounding the apparatus are described.

SACHS, H.G. (1952) Zur Morphologie von Acarapis. (2) Bau des Kopulationsapparates der Tracheenmilbe Acarapis woodi woodi Rennie, 1921. [On the morphology of Acarapis. (2) Structure of the copulatory organs of the tracheal mite.] Zeitschrift für Bienenforschung 1(9) : 174-178 [De, B, AA285/53]
The male reproductive organs are described. Mating could not be induced between mites freshly extracted from honeybee tracheae.

SACHS, H. (1953) Zur Morphologie von Acarapis. (3) Bau und Funktion der Biene von Acarapis woodi Rennie. [... Form and function of the legs of Acarapis woodi. Zeitschrift für Bienenforschung 2(1) : 1-7 [De, B, AA118/56]
The morphology and function of the sense organs of the legs is described and illustrated for both male and female adult mites.

2.33 PHYSIOLOGY, LIFE CYCLE, BEHAVIOUR

GIORDANI, G. (1962) Ricerche di laboratorio su Acarapis woodi Rennie agente dell' acariosi delle api (Apis mellifera L.). [Laboratory research on Acarapis woodi Rennie, cause of acarine disease of the honeybee.] Apicoltore d'Italia 29 : 4-7, 27-31 [It, B, AA168/65]

In small colonies kept in the laboratory, mites usually survived their host by 12-13 h. Newly emerged healthy bees introduced into infested colonies are quickly infested, usually be a single female mite. It is suggested that the female lays its eggs then moves on to parasitize another bee.

GIORDANI, G. (1962) Recherches au laboratoire sur Acarapis woodi Rennie, agent de l'acariose des abeilles (Apis mellifica L.). Note 1. [Laboratory experiments on Acarapis woodi Rennie. Note 1.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 5(1) : 33-51 [Fr, en, de, es, B, AA348/65]

In an examination of 700 bees from colonies in which about 20% of bees were infested, very few external migratory A. woodi were found (and none at the wing bases). Experimental infestation of young bees, 0-10 days old, showed that newly emerged bees are usually the most susceptible.

GIORDANI, G. (1963) Ricerche di laboratorio su Acarapis woodi Rennie, agente della acariosi delle api (Apis mellifica L.). Nota 2. [Laboratory experiments on Acarapis woodi. Note 2.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 6(2) : 185-203 [It, en, de, es, B, AA349/65]

Acarine mites infesting honeybees in autumn survived longer after the death of their host and were more likely to move to the wing bases of live bees. Neither the structure nor the function of a bee's pharyngeal glands was affected by Acarapis infestation.

GIORDANI, G. (1964) Ricerche di laboratorio su Acarapis woodi Rennie agente della acariosi delle api (Apis mellifica L.). Nota 3. [Laboratory research on Acarapis woodi. Note 3.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 7(1) : 43-60 [It, Fr, en, de, es, B, AA350/65]

The brown spots characteristic of tracheae heavily infested with acarine mites were studied. Their pigment was shown by histochemical methods to be melanin.

GIORDANI, G. (1965) Ricerche di laboratorio su Acarapis woodi Rennie, agente dell'acariosi delle api (Apis mellifica L.). Nota 4. [Laboratory research on Acarapis woodi Rennie, cause of acarine disease of the honeybee. Note 4.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 8(2) : 159-176 [It, Fr, en, de, es, B, AA360/67]

The mites were found not only in the prothoracic tracheae but also in air sacs of the head, thorax and abdomen. Tracheae were observed free of infestation at the external ends but with heavily infested deep ramifications. In winter, infestation was not confined to bees already infested, but could spread to others. When acarine mites were taken directly from diseased bees and placed on the teguments of larvae 4-5 days old and young pupae, some of them lived for 9-10 days and a few for 13 days.

GIORDANI, G. (1967) On the laboratory rearing of Acarapis woodi Rennie. Abstracts, XXI International Beekeeping Congress No. 44 : 70 [En, B, AA618/67]

2.33 continued

Mites could be reared on honeybee larvae, just after their cells were sealed, placed on paraffin "beds" in an incubator at 28°C, RH70%. Of 879 mites put into cells, 236 lived more than 8 days, and 7 more than 30. Breeding occurred, and 88 eggs hatched, of which 22 developed to adults. Immature stages could be cultured in the same way, and 107 adults were obtained from 200 immature stages put in cells.

GIORDANI, G. (1967) Laboratory research on Acarapis woodi Rennie, the causative agent of acarine disease of the honeybee. Note 5. Journal of Apicultural Research 6(3) : 147-157 [En, B, AA252/68]

Further information on rearing of mites on sealed honeybee larvae, including feeding, movement and reproduction of the mites.

GIORDANI, G. (1970) Ricerche di laboratorio su Acarapis woodi Rennie agente dell'acariosi delle api mellifiche (Apis mellifera L.) - Nota 6. [Laboratory investigations on Acarapis woodi the agent of acarine disease in honeybees - Note 6.] Annali Accademia Nazionale di Agricoltura, Bologna 90 : 69-76 [It, en, B, AA813/71]

Males lived slightly longer than females. Under natural conditions, more females were produced than males (4.3:1). Mites showed greater resistance and vitality (longer life, more eggs) in autumn than in spring and summer.

The haemolymph of honeybee prepupae inhibited the seasonal stimulation and ovary development of mites. This may be because the prepupal haemolymph has a different composition from that of adult bees, and because of interaction between the reproductive cycles of host and parasite.

HIRSCHFELDER, H. (1952) Das Verhalten der Tracheenmilbe Acarapis woodi R. beim Verlassen und Aufsuchen der Wirtsbienen. [Behaviour of the tracheal mite in leaving and finding host bees.] Zeitschrift für Bienenforschung 1(8) : 141-147, 170 [De, B, AA283/53]

Most mites leave the tracheae after the death of the bee. Individual mites take about one minute to pass through the barrier of hairs around the first spiracle. Most mites remain on the thorax; they usually climb to the tip of a hair which they grip with one or both hind legs, leaving the other legs free (the 'ambush' position). They die here after a few hours unless they are able to seize hairs from another bee which brushes against them, and so transfer themselves to another host. When mites were placed on wax foundation very few of them seemed capable of actively finding a new host, even when a bee was secured to the foundation.

HIRSCHFELDER, H.; SACHS, H. (1952) Recent research on the acarine mite. Bee World 33(12) : 201-209 [En, B, AA287/53]

This is a summary of papers by Hirschfelder and Sachs in Zeitschrift für Bienenforschung. Tracheal mites leave tracheae of dead bees, and attach themselves by their hind legs to the ends of hairs in an 'ambush' position, usually passive but occasionally (under the stimulus of passing hairs) groping with their fore-legs, and so attaching themselves to hairs of other contacting bees. Mites are then attracted by vibration to the bases of the wings, but this is subordinate to the attraction of the intermittent air stream from the first thoracic spiracle. The mite penetrates the spiracle by positive thigmotaxis (tendency to achieve complete contact of the body with solid surfaces), and this keeps it

2.33 continued

under the protergal lobe. The barrier of stiff hairs around the edge of the latter gives old bees a greater resistance, the structure itself preventing the entry only of heavily gravid females. The mite's mouthparts are pictured and described. Tracheal mites outside can feed by penetrating the exoskeleton, not necessarily the thinnest parts.

KAESER, W. (1951) Some investigations on the biology of the internal mite Acarapis woodi) of the honeybee. Papers, XIV International Beekeeping Congress No. 2 : 4 pages [En, Fr, De, B, AA170/51]

The following results are reported: within the tracheae, mites outlive bees over all ranges of temperature and humidity; "exposed" mites have a shorter life than bees from 20° to 50°C.; they are also more resistant than bees to reduced air pressure, and more resistant than bees to pure CO_2, SO_2, KCN and nicotine. Immersed in vaseline, mites have a considerable length of life at all temperatures (11-12 days at 4°C).

KAESER, W.; KOENIG, W. (1953) Untersuchungen zur Atmung der Innenmilbe Acarapis woodi) der Honigbiene. [Investigations on the respiration of the internal acarine mite of the honeybee.] Zeitschrift für Bienenforschung 2(3) : 117-120 [De, B]

ÖRÖSI-PÁL, Z. (1934) Über die Ernährung der Acarapis-Milben der Honigbienen. [Nutrition of the Acarapis mite of honeybees.] Entomologische Beihefte aus Berlin-Dahlem 1 : 136-138 [De, B]

ÖRÖSI PÁL, Z. (1936) Újabb vizsgálatok a házi méhen élősködő Acarapis-lárvák táplálkozásáról. [New investigation on the nutrition of the Acarapis larva.] Abhandlungen aus dem zoologischen Institut der St. Tisza Universität (31) : 66-73 + 2 pl. [Hu, De, B]

SACHS, H. (1952) Ueber das Verhalten und die Orientierung der Tracheenmilbe Acarapis woodi woodi (Rennie 1921) auf Bienen. [Behaviour and orientation of the tracheal mite on bees.] Zeitschrift für Bienenforschung 1(8) : 148-170 [De, B, AA284/53]

Mites placed on the head, abdomen or legs of living bees generally climbed a hair and assumed the 'ambush' position. Some mites placed on the thorax moved towards the wing bases, and if placed about 1 mm from the first spiracle they moved towards it and tried to penetrate its barrier of hairs. If the bee was old they could not do this because the hairs were too stiff, so they either climbed a hair to the 'ambush' position or generally went to the wing roots. It was proved that mites could feed at the wing bases, on the thorax, at the neck and at the limb joints.

The behaviour of mites was observed when placed near the ends of a capillary tube or tubes connected internally to the first spiracle of empty thoraces. The only stimulus causing mites to approach the openings was intermittent puffs of air (about 120 per min.). The vapours of mustard oil, Frow's mixture, methyl salicylate, or the scent of young or old bees when mixed with this air, did not interfere with the response of the mites to this stimulus.

SACHS, H. (1958) Versuche zur Züchtung der Tracheenmilbe Acarapis woodi woodi. [Experiments on rearing Acarapis woodi.] Zeitschrift für Bienenforschung 4(6) : 107-113 [De, B, AA250/59]

2.33 continued

The length of life of acarine mites in different media was investigated. In pure water, with or without Congo Red, they lived 3 days; enclosed in vaseline they lived up to 3 days, the vaseline being consumed and large amounts of saliva being produced. In fructose solutions with different amino acids added, they lived 6 days. The maximum length of life in bee haemolymph + penicillin + aureomycin was 11 days; eggs were laid, and larvae developed from the eggs laid, in the culture solution.
It was possible to tell the sex from the size of the egg, or better still from the size of the larva. On a medium of bee haemolymph + 1% agar + 0.1% "vitamin T" (Goetsch) the mites could be reared from egg to adult. Mated females reared in cultures from the egg laid eggs on the medium only after a period of "maturing feeding" in young bees.

SCHNEIDER, H. (1960) Problèmes biologiques de l'Acarapis des abeilles. [Biological problems concerning Acarapis of bees.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 3(1) : 37-49 [Fr, De, en, es, B, AA687/62]

Earlier work on the disease is described. The author's experiments on the weight required to pull the wings from healthy and from acarine infected bees are discussed. It is suggested that it is the damage by A. woodi to the wing bases, and not the obstruction of the respiratory tracts, which causes paralysis in infected bees. Work done on the external mites is reviewed, and measurements which have been made comparing three species of these and A. woodi are given.

2.4 HONEYBEES INFESTED WITH ACARAPIS WOODI

2.41 DIAGNOSIS

COLIN, M.E. (1983) Diagnostic de l'acariose. [Diagnosis of acarine disease.] Bulletin d'Information des Laboratoires des Services Vétérinaires No. 10 : 53-55 [Fr, B, AA597L/84]

COLIN, M.E.; FAUCON, J.P.; GIAUFFRET, A.; SARRAZIN, C. (1979) A new technique for the diagnosis of acarine infestation in honeybees. Journal of Apicultural Research 18(3) : 222-224 [En, B, AA569/80]

> A new technique for the diagnosis of acarine infestation of honeybees consists of grinding the thorax, and centrifuging and examining the deposit. It proved to be both sensitive and quantitative, and can be rapid, even with large samples of bees. Some of the results obtained with it are discussed in relation to the pathogenicity of the mite to the honeybee.

GONZÁLEZ, A.R. ET AL. (1985) Acariasis in Apis mellifera L. in Cuba. Assessment of a technique.

> The full entry, with annotation, is in 2.21.

HOHNER, L. (1978) Entnahme und Versand von Bienen aus dem Wintertotenfall zur Untersuchung auf Milbenseuche. [Removal of honeybees from the hive debris accumulating in the winter, and sending them for examination for acarine disease.] Jahrbuch der Imkers : 146-154 [De, B]

LAVIE, P. (1950) Nouvelles recherches sur le traitement de l'acariose. Notes préliminaires. [New research on the treatment of acarine disease. Preliminary notes.] Revue Française d'Apiculture 12(52) : 21-24; (53) : 25-27 [Fr, B, AA111/50]

> This review includes: life history of A. woodi; treatment (agents include sulphur, methyl salicylate, Frow's mixture and Mito A_2); effects of some physical and chemical agents on bees and mites.

MINISTRY OF AGRICULTURE AND FISHERIES (1950) The examination of bees for acarine disease. Advisory Leaflet, Ministry of Agriculture and Fisheries No. 362 : 6 pp. [En, B, AA53/51]

> This leaflet is intended to help beekeepers to carry out the dissection of the honeybee for the diagnosis of acarine disease. Three clear diagrams show the method of dissection, and four photomicrographs show infested tracheae. The apparatus described is simple and inexpensive.

MINISTRY OF AGRICULTURE, FISHERIES AND FOOD (1970) Examination of bees for acarine. London, UK : Advisory Leaflet, Ministry of Agriculture, Fisheries and Food No. 362 : 6 pp. [En, B, AA442L/74]

SCHNEIDER, H.; BRÜGGER, A. (1949) Comment peut-on diagnostiquer l'acariose sans microscope? [How can acarine be diagnosed without a microscope?] Bulletin de la Société Romande d'Apiculture 46(12) : 372-375 [Fr, B, AA87/50]

> In winter all stages of the acarine mite are found outside the tracheae at the base of the wings, where they suck blood by piercing the body wall. Infested bees become crawlers, but not all crawling is due to acarine. A hind wing plucked off a crawler comes away readily if acarine is the cause, and part of the chitinous body wall comes away attached to the wing. If acarine is not the cause, the wing is more firmly attached and it comes away clean. Photographs show the difference, which is very marked.

2.41 continued

SCHNEIDER, H. (1960) Problèmes biologiques de l'Acarapis des abeilles.
The full entry, with annotation, is in 2.33.

SCHONBRODT, A.; HALEN, P. (1981) Comparaison de deux méthodes de dépistage de l'acariose des abeilles. [Comparison of two techniques for the diagnosis of acarine disease in honeybees.] Annales de Médecine Vétérinaire 125(8) : 651-655 [Fr, en, B, AA598/83]
The normal diagnostic method involves the dissection and examination by microscope of individual dead bees. In a method proposed by Colin et al. (1979) the thoraces of 20-200 bees are ground and prepared for examination by microscope. The latter method was found to be more sensitive for either fresh or decomposing samples.

USINGER, W. (1954) Eine neue Methode zur Untersuchung auf Tracheenmilben im Winter-totenfall. [A new method of examining samples of dead winter bees for acarine disease.] Zeitschrift für Bienenforschung 2(5) : 158-159 [De, B, AA120/56]
After preparation, the bee's thorax is viewed from a dorsal aspect; 10-12 samples each containing 20-25 bees can be examined in 1h. Healthy and acarine-infested tracheae are clearly distinguished by transmitted light.

VERTES, E.; ÉRCES, K. (1980) A mézelő méh légcsőatka szűrővizsgálata Bretschko- és Svoboda-féle módszerek összehasonlításával. [Comparison of the methods of Bretschko and Svoboda for the screening of honeybees for acarine disease.] Magyar Allatorvosok Lapja 35(11) : 787-788 [Hu, B, AA1401L/81]

WIESE, H.; MEYER, C.R. (1975) Contribuição para o reconhecimento da acariose em Apis mellifera L. [[Visual] method for recognizing infestation of bees with acarine disease.] Pages 207-210 from "Anais do 3° Congresso Brasileiro de Apicultura, 1974", Piracicaba, Brazil [Pt, en, E1496, B, AA1288L/77]
Unequal dislocation of the hind-wings proved a quick (and 70% efficient) method for detecting acarine disease in Brazil.

WIESE, H.; MEYER, C.R.; SANDE, C. VAN DE (1975) Contribution au diagnostic de l'acariose chez Apis mellifica L. [Diagnosis of acarine disease in the honeybee.] Santé de l'Abeille 35 : 74-75 [Fr, B, AA1289L/77]

WOJTEK, H. (1955) Zur Diagnose und Verbreitung der Milbenseuche der Honigbiene. [Diagnosis and distribution of acarine disease.] Zentralblatt für Veterinärmedizin 2(7) : 674-681 [De, B, AA296/58]
The best method found for dissecting bees for the detection of infection by A. woodi was the removal of the head, together with the anterior part of the thorax, by severing the thorax with scissors behind the first thoracic spiracles, just before the wing-rods. By this method the tracheal trunks infected by A. woodi are left in the anterior part of the thorax, and can be examined easily with a binocular microscope.
Percentage infections of colonies in spring 1955 in North and South Bavaria and the Black Forest were 21.9, 18.4 and 3.8 (out of samples of 328, 2889 and 104 colonies from each region).

2.42 BIOLOGY

ATWAL, A.S. (1971) Acarine disease problem of the Indian honey bee, Apis indica F.
The full entry, with annotation, is in 2.13.

BAILEY, L.; LEE, D.C. (1959) The effect of infestation with Acarapis woodi (Rennie) on the mortality of honey bees. Journal of Insect Pathology 1(1) : 15-24 [En, B, AA235/60]
Except in bees that were heavily and bilaterally infested, infestation did not increase honeybee mortality. In colonies made (artificially) queenless for 3-9 weeks in summer, the percentage of infested bees increased. Possible reasons are suggested.

BAILEY, L. (1961) The natural incidence of Acarapis woodi (Rennie) and the winter mortality of honeybee colonies. Bee World 42(4) : 96-100 [En, B, AA487/62]
The incidence of A. woodi in untreated colonies is tabulated for 6 years, with colony mortality for successive winters. Only a small proportion developed heavy infestations. The proportion of infestations detectable by autumn was clearly correlated with the type of the previous season, and it is inferred that when colonies collect honey substantially surplus to their winter needs, the susceptible newly emerged bees have less contact with the mites, which do not migrate until their host bees are at least two weeks old. There was a significantly higher mortality of colonies with more than 30% bees infested, but many bees died from other causes. The results show that acarine disease was naturally checked, and that damage by it was not very great.

KOENIG, M. (1953) Ueber den Stickstoffund den Aminosäuregehalt des Bienenblutes. [Nitrogen and amino-acid contents of bee blood.] Naturwissenschaften 40 : 583 [De, B, AA406/57]
In bees confined for 30 days at 24°C. without nitrogen, the blood nitrogen dropped from 1.6 to 1.4%; at 38° the drop was more rapid. In bees infested with A. woodi, the blood nitrogen was lower, and it dropped faster. The blood content varied from 11 to 17.5 mm^3 per bee. Its peptide content was 6-7% by chromatographic analysis. In confinement without nitrogen the protein decreased to 5%. Besides the acids of the albumins and globulins, 2-3% free amino acids were present; these disappeared first in captivity without nitrogen.

ÖRÖSI-PÁL, Z. (1937) Über den Klebstoff der Milbe Acarapis woodi Rennie in der Tracheen der Honigbiene. [Adhesive substance of the mite Acarapis woodi Rennie in the trachea of the honeybee.] Zeitschrift für Parasitenkunde 9(5) : 669-673 [De, B]

ÖRÖSI-PÁL, Z. (1938) Der Brutplatz der Acarapismilben auf dem Hinterleib der Honigbiene. [The breeding place of the acarine mite on the abdomen of the honeybee.] Deutsche Imkerführer 12(2) : 60-61 [De, B]
Reviewed in Bee World 19(7) : 80 (1938); breeding place and brood of A. externus are on 2nd abdominal segment. Also mentions A. woodi.

ROUSSEAU, M.; TABARLY, O.; MONTEIRA, E. (1959) Formes atypiques d'acariose. [Atypical forms of acarine disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 2(2) : 29-36 [Fr, B, AA455/61]

2.42 continued

Infected apiaries did not show diseased or dead bees, but colony populations and yields were low. Examination showed an extremely low proportion of foragers to young bees; a few bees were heavily infected with acarine mites. The colonies recovered after treatment for acarine disease. The appearance of an atypical form of the disease was attributed to incomplete treatment of infected colonies, and the use of preventive treatments.

SCHNEIDER, H. (1960) Problèmes biologiques de l'Acarapis des abeilles.
The full entry, with annotation, is in 2.33.

SINGH, S. (1957) Acarine disease in the Indian honey bee. Indian Bee Journal 19(3/4) : 27-28 [En, B, AA341/59]

Colonies of bees at the Government Bee Farm at Katrain were noticed in 1956 to be dwindling rapidly. Signs were: large number of bees in front of the hive unable to fly, dislocated and unco-ordinated wings, distended abdomens, dysentery, unpleasant smell in the hive, with bees moving aimlessly or clustered in small groups. The presence of mites resembling A. woodi in the thoracic tracheae was diagnosed; the mites were identified as A. woodi.

ŠKROBAL, D. (1965) Agents qui influencent le métabolisme respiratoire chez les abeilles acariosées (Apis mellifica L.). [Factors affecting the respiratory metabolism of acarine-infested honeybees.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 8(2) : 177-180 [Fr, B, AA136/67]

Immobilized healthy and infested workers were studied at 21° and 35°C. In the initial stages of disease, no differences in rate of oxygen consumption were observed between healthy and unhealthy bees. At a more advanced stage, the metabolic rate increased in comparison with healthy bees, particularly at the higher temperature. In heavily infested and dying bees, it dropped sharply at 35°.

2.43 CONCURRENCE OF MICRO-ORGANISMS

BAILEY, L. (1965) Susceptibility of the honey bee, Apis mellifera Linnaeus, infested with Acarapis woodi (Rennie) to infection by airborne pathogens. Journal of Invertebrate Pathology 7(2) : 141-143 [En, B, AA811/65]

Honeybees infested with A. woodi were no more susceptible than normal bees to infection by the bacterium Pseudomonas apiseptica or by the viruses causing acute and chronic paralysis, when they were sprayed with suspensions of these pathogens.

DÖTTERL, H. (1960) Über Nosemabefall bei milbenfreien und milbenverseuchten Bienenvölkern. [Nosema disease in mite-free and mite-infested honeybee colonies.] Munich, German Federal Republic : Inaugural Dissertation 27 pp. [De]

LAVIE, P. (1951) Investigations on a mysterious micro-organism, Acaromyces laviae, which appears to be a parasite of Acarapis woodi. Papers, XIV International Beekeeping Congress No. 20 : 3 pp. [En, Fr, De, B, AA171/51]

A yeast was found associated with A. woodi within the tracheae of living bees. Most of the mites (98-99%) were dead. In sections the yeast was seen on and in the mite and on the tracheal walls; it was 1-3 microns in

2.43 continued

size. The yeast was cultured successfully and belongs to the Candida guilliermondii group. Colonies infested with acarine mites were successfully infected with the yeast by dusting with its spores in autumn. After one month 15-40% of the mites were dead. The yeast seems to be specifically associated with A. woodi.

LAVIE, P. (1952) Premiers résultats obtenus dans les essais de traitement de l'acariose au moyen de l'acaromyces. [First results in the experimental treatment of acarine disease by Acaromyces.] Apiculteur 96(2) Section Scientifique No. 1 : 1-8 [Fr, B, AA20/53]

Experiments are described in which the yeast Acaromyces (earlier found associated with A. woodi in the tracheae of bees) was used for treating acarine disease. Altogether 124 colonies were treated (87 diseased) and 60 untreated colonies served as controls. The experiments were carried out in the Departments of Orne and Oise (both near Paris), and in Corsica, where almost all colonies suffer from acarine disease. The treatment consisted of spraying each frame - or each end of a fixed-comb hive - with a suspension of the yeast in physiological saline, the amount used for one hive being about equivalent to the growth developing on a solid medium in a sloping culture tube. In general treated colonies recovered - some of them most spectacularly - whereas untreated colonies did not. Acaromyces was present in the healthy tracheae of treated bees some months later. The results are quoted in general terms and isolated case-histories cited; tables of results for individual colonies are not given, nor any statistical analysis.

WILLE, H. (1966) Die Milbe (Acarapis woodi) im Zusammenhang mit anderen Krankheitserregern. [The acarine mite in relation to other causative organisms of bee diseases.] Südwestdeutscher Imker 18(11) : 322-324 [De, B, AA137/67]

Scientific opinion is still very divided on the danger of A. woodi to bees, the USA forbidding importation of bees for fear of infestation, but Bailey and others regarding it as a harmless parasite. In 1963-66 the author found that many bees with an acarine infestation also had other diseases such as bacterial septicaemia, amoeba cysts, and disintegration of the thoracic muscles; there was very little nosema.

2.44 RESISTANCE AND SUSCEPTIBILITY TO THE MITE

ADAM, BROTHER (1962) Einige Erfahrungen mit der Milbenseuche. [Experiences with acarine disease.] Bienenvater 83(2) : 35-38; (3) : 79-81 [De, B, AA397/63]

Breeding experiments which led to strains that appeared resistant to the acarine mite are described. Imported American queens produced bees that were very susceptible, but none of the 48 colonies of the author's strain in the apiary became infested. He argues that this shows resistance, not immunity. No chemical treatment is ever used at Buckfast, as this would invalidate conclusions as to which colonies or strains are resistant.

ADAM, BROTHER (1985) The acarine disease menace - short-term and long-term countermeasures. American Bee Journal 125(3) : 163-164 [En, B]

Covers historical aspects; also deals with requeening of infested colonies with queens of proven resistant stock.

2.44 continued

ALEKSEENKO, F.M.; VOVK, R.M. (1972) Age and race resistance of bees to acarine disease and new means for its control. Pages 481-483 from "Proceedings of the XXIII International Apicultural Congress, Moscow, 1971", Bucharest, Romania : Apimondia Publishing House [En, Fr, De, Ru, B]

BAILEY, L. (1965) The effect of *Acarapis woodi* on honeybees from North America. Journal of Apicultural Research 4(2) : 105-108 [En, B, AA161/66]

Of 19 colonies infested with *A. woodi* in spring 1963, 9 were requeened with queens from North America; 2 of these became severely infested in 1963 and one in 1964. Of the 10 colonies left with English queens, one became severely infested in 1964. Infestation declined or remained slight in all the remaining colonies. *A. woodi* spread quickest in late summer in American bees, as it does in English ones. Severely infested colonies of both American and English bees appeared normal until their death in late winter.

BAILEY, L. (1967) The incidence of *Acarapis woodi* in North American strains of honeybees in Britain. Journal of Apicultural Research 6(2) : 99-103 [En, B, AA380/68]

A. woodi was detectable in a larger percentage of colonies of "American" bees in Britain than of "British" bees in the same locality. Most infestations remained slight. British bees added to colonies of American bees became equally infested; so, individually, American bees are no more susceptible to infestation than British bees.

CALVERT, F.W.M. (1957) Acarine disease: four years' experience with resistant strain of bees. Scottish Beekeeper 33(3) : 39-41 [En, B, AA337/58]

Using pure Buckfast queens and first-cross queens from this strain, it took 12 months to eliminate acarine disease from an apiary, which had been heavily infested. Diseased and resistant stocks were kept in close proximity, without any sign of infestation of the resistant strain. Observations were aided by the colour of the bees, the original strain being black, and the Buckfast strain banded.

COOPER, B.A. (1957) Breeding for acarine resistance. Bee Craft 39(5) : 42 [En, B]

LEE, D.C. (1963) The susceptibility of honey bees of different ages to infestation by *Acarapis woodi* (Rennie). Journal of Insect Pathology 5(1) : 11-15 [En, B, AA168/64]

Although older bees are less frequently infested than young bees, this is probably due to the older bees being less attractive. Removing some of the guard hairs near the anterior thoracic spiracle, or severing the muscle to prevent closing of the spiracle, did not increase the mite infestation of old bees. Amputation of the middle leg increased mite infestation only when the bees were anchored with wax.

ÖRÖSI-PÁL, Z. (1935) Die Altersimmunität der Honigbiene gegen die Milbe *Acarapis woodi*. [The age of immunity of the honeybee from *Acarapis woodi* mite.] Zeitschrift für Parasitenkunde 7(4) : 401-407 [De, B]

STEJSKAL, M. (1959) *Acarapis woodi* Rennie Milbenbekampfung mit Hilfe der Genetik. [*Acarapis woodi* Rennie controlled by help of genetics.] Bienenmutterchen 11(7/8) : 7-10 [De, B, AA66/61]

2.44 continued

The author believes that the Sklenar (Carniolan) bee is a strain resistant to acarine disease, selective breeding for fifty years having overcome susceptibility to the disease to such an extent that it practically never occurs.

2.45 BEES OTHER THAN APIS MELLIFERA

ADLAKHA, R.L. (1976) Acarine disease of adult honey bees in India.
The full entry, with annotation, is in 2.21.

ATWAL, A.S. (1967) Acarine disease problem of honey bees inATWAL, A.S. (1967) Acarine disease problem of honey bees in the Punjab.
The full entry, with annotation, is in 2.21.

ATWAL, A.S.; DHALIWAL, G.S. (1969) Robbing between *Apis indica* F. and *Apis mellifera* L. American Bee Journal 109(12) : 462-463 [En, B, AA140/71]
Intermingling of the two species during robbing at Nagrota (120 m) was believed to have spread acarine disease from *Apis cerana* to *Apis mellifera*. At Ludhiana *Apis dorsata* never attacked *Apis mellifera*.

ATWAL, A.S.; SHARMA, O.P. (1970) Acarine disease of adult honeybees: prevention and control. Indian Farming 20(2) : 39-40 [En, B, AA761/72]
A. woodi is responsible for 25-40% annual loss of colonies in northern India and is being spread by swarms infected with the mite. *Apis dorsata* and *Apis florea* are considered immune. Treatment with methyl salicylate is recommended during the brood-rearing season and in summer; chlorobenzilate and methanol were also effective. [Deals with *Apis cerana*.]

ATWAL, A.S. (1971) Acarine disease problem of the Indian honey bee, *Apis indica* F.
The full entry, with annotation, is in 2.13.

DELFINADO-BAKER, M.; KNOX, D. (1982) Infestations of *Apis cerana indica* colonies by *Acarapis woodi* and *Varroa jacobsoni*.
The full entry, with annotation, is in 2.21.

DELFINADO-BAKER, M.; BAKER, E.W. (1982) Notes on honey bee mites of the genus *Acarapis* Hirst (Acari: Tarsonemidae).
The full entry, with annotation, is in 4.1.

DELFINADO-BAKER, M.; BAKER, E.W. (1983) A new species of *Neocypholaelaps* (Acari : Ameroseiidae) from brood combs of the Indian honey bee. Apidologie 14(1) : 1-7 [En, de, fr, B, AA801/84]
Neocypholaelaps apicola n. sp. is described from specimens found in brood combs of *Apis cerana* from Pakistan. It is not known if this mite is harmful. A list of known species of *Neocypholaelaps* is included. Adult bees were also infested by the tracheal mite *A. woodi*.

DEODIKAR, G.B. (1971) Dangers from introduction of exotic pathogenic diseases through import of useful insects like bees, silkworms or lac-insects. Indian Bee Journal 33(1/2) : 1-2 [En, B, AA395/73]

2.45 continued

DHALIWAL, H.S.; SRIVASTAVA, S.; SHARMA, P.L. (1974) Some biological observations on the mite, Acarapis woodi Rennie, infesting honeybees, Apis cerana indica F. Current Science 43(23) : 750-752 [En, B, AA1125/78]

Infested bees from a hill area of Solan, India, were examined. Bees 2-7 days old were most susceptible to attack by the parasite, and incidence was highest in bees 3-4 days old. After the death of the bee host, the mites usually died within 24 h, and no mite was found on a honeybee 42 h after death. As a dying bee usually falls away from the cluster or leaves the hive, the spread of the infestation from dead bees is probably unimportant.

DINABANDHOO, C.L.; DOGRA, G.S. (1979) Dichlorvos for the control of acarine disease of Indian honey bee, Apis cerana Fab. Indian Bee Journal 41(1/2) : 1-4 [En, B, AA813/81]

Dichlorvos, an insecticide/acaricide with a fumigant action, was used to treat Apis cerana colonies infested with A. woodi; 10 ml of dichlorvos solution (50 ppm) was applied to a strip of blotting paper stapled to an empty frame. To avoid direct contact by bees, the strip was enveloped by perforated paper. A treatment frame was put into the brood chamber in the spring (3 treatments each of 12 h, at intervals of 2 days) or in the autumn (5 treatments each for 24 h on alternate days).

No mites were found on bees examined after treatment. The uptake of dichlorvos by the bees was calculated to be 250-500 ng per colony (5000-10 000 bees), which is considered a safe level.

DINABANDHOO, C.L.; DOGRA, G.S. (1983) The acarine induced decline in Indian honeybee Apis cerana indica F. and its control in Kulu valley. Pages 435-441 from "Proceedings of the Second International Conference on Apiculture in Tropical Climates, New Delhi, February 19-March 4, 1980" [En, B]

Acarine disease has reduced the number of Apis cerana colonies in this valley. Treatments with Folbex and methyl salicylate were not effective, but 15 colonies treated with dichlorvos recovered completely.

INDIA. INDIAN STANDARDS INSTITUTION (1977) Specification for [chlorobenzilate] fumigant strips for treatment of honey-bees. Indian Standard No. 8444-1977 : 6 pp. [En, B, AA475L/81]

For treatment of acarine disease in Apis cerana.

KSHIRSAGAR, K.K. (1966) A review of work on acarine disease of honeybees.

The full entry, with annotation, is in 2.21.

KSHIRSAGAR, K.K.; MITTAL, M.C.; MAHINDRE, D.B.; SALVI, S.R.; CHAUHAN, R.M. (1983) Seasonal fluctuations in the incidence of acarine disease in bees and colony losses in India. Pages 442-453 from "Proceedings of the Second International Conference on Apiculture in Tropical Climates, New Delhi, February 19-March 4, 1980" [En, B, AA800/85]

Monthly samples of worker honeybees [presumably Apis cerana] were taken from colonies in experimental apiaries at Kangra (Himachal Pradesh) and Pathankot (Punjab) in 1965-1978, and from Srinagar (Kashmir) in 1969-1978. The levels of A. woodi infestation varied from month to month, and from year to year, although there was a trend for infestations to become more severe during winter (November-January), and to decline in summer (May-June). Colonies often had nosema disease or viral diseases as well as an A. woodi infestation, or they were not adequately prepared for winter. Overall, 42% of the colonies which were lost in Himachal

2.45 continued

Pradesh, and 51% of colonies lost in Kashmir, were not infested by A. woodi. It is suggested that colony losses, attributed to A. woodi infestations by beekeepers in these areas, may be due partly to several other factors.

KSHIRSAGAR, K.K.; SALVI, S.R.; MAHINDRE, D.B.; CHAUHAN, R.M. (1983) Menthol as an effective acaricidal fumigant. Pages 454-456 from "Proceedings of the Second International Conference on Apiculture in Tropical Climates, New Delhi, February 19-March 4, 1980" [En, B, AA807L/85]
Menthol, used in fumigant strips, was effective in treating acarine disease [in Apis cerana?] in N. India.

RISHI, N.D. (1983) On the occurrence of some diseases and predators of Apis cerana indica F. in Kashmir. Pages 466-472 from "Proceedings of the Second International Conference on Apiculture in Tropical Climates, New Delhi : February 19-March 4, 1980" [En, B, AA808L/85]
Acarine disease reaches a peak in December-January. It is suggested that A. woodi carries Kashmir bee virus and Apis iridescent virus from one colony to another.

SHAH, F.A.; SHAH, T.A. (1978) Control of acarine in the Kashmir valley. Indian Bee Journal 40(2) : 36-38 [En, B, AA236L/81]
Deals with Apis cerana.

SINGH, J.P.; TALWAR, R.C. (1969) Acarine infestation of honey bees Apis indica Fabr. Labdev : Journal of Science and Technology, India 7B(4) : 282-285 [En, B, AA1017L/72]
Apis cerana.

SINGH, S. (1957) Acarine disease in the Indian honey bee (Apis indica F.).
The full entry, with annotation, is in 2.42.

SINGH, S.; ADLAKHA, R.L. (1958) Acarine disease of adult honey-bees.
The full entry, with annotation, is in 2.21.

SINGH, S.; ADLAKHA, R.L. (1960) Survey of acarine disease of adult honeybees in Simla Hills.
The full entry, with annotation, is in 2.21.

SINGH, Y.; VERMA, S.K. (1981) Occurrence of acarine disease in Apis cerana indica in Uttar Pradesh (India). Indian Bee Journal 43(2) : 37-39 [En, B, AA785L/82]

2.5 GENERAL AND NON-CHEMICAL CONTROL

2.51 GENERAL

ALEKSEENKO, F.M. (1973) [Effectiveness of chemical treatments during acarine disease of honeybees.]
The full entry, with annotation, is in 2.22

ALEKSEENKO, F.M.; VOVK, A.M. (1975) [*Acarapis* infection of honeybees and its control.] Veterinariya, Moscow, USSR No. 6 : 78-79 [Ru, AA244L/78]

BORCHERT, A. (1936) Richtlinien für Imkersachverständige bei der Bekämpfung der bösartigen Faulbrut und der Milbenseuche. [Right lines for beekeeping experts for the control of AFB and acarine disease.] Deutsche Imkerführer 10(3) : 85-89 [De, B]

BUTLER, C.G. (1941) A possible new cure for acarine disease of honeybees. Nature, UK 148 : 86 [En, B]

OZEROV, A.P. (1979) [Fan-type mite-trapping bracket.] Pchelovodstvo No. 2 : 20 [Ru, B]
For control of *Varroa jacobsoni* and acarine mites, and ventilation of beehive.]

ZMARLICKI, C. (1984) Beekeeping with *Apis mellifera* and mite control in Burma.
The full entry, with annotation, is in 2.21.

2.52 CONTROL USED IN INDIVIDUAL COUNTRIES

ADAM, BROTHER (1968) "Isle of Wight" or acarine disease: its historical and practical aspects.
The full entry, with annotation, is in 2.12.

BUZA, L. (1976) A mézelő méhek légcsőatkakórjáról (Acarapidosis apium). [Acarine disease of honeybees.] Magyar Állatorvosok Lapja 31(2) : 130-133 [Hu, en, de, ru, B, AA660/79]
Figures for the incidence of acarine disease in Hungary from 1964 to 1975 show that most outbreaks occurred along the Austrian border. Preventive measures used in Hungary include regular examinations and the use of Folbex in the Austrian border zone in the autumn.

DIANA, E. (1951) L'apicoltura sarda in crisi. [Crisis in Sardinian beekeeping.] Apicoltore d'Italia 18(7/8) : 159 [It, B, AA115/52]
It is now stated that 75% of Sardinian bees are affected by acarine disease, and that the local government has set aside one million lire for treating it. This should make it possible to eradicate the disease from one district.

FEILING, O. (1956) Die Entwicklung der Milbenseuche im Bundesgebiet und ihre Bekämpfung. [The development and control of acarine disease in the [German] Federal Republic.] Monatshefte für Tierheilkunde 8(12) : 291-309 [De, B, AA627/63]

2.52 continued

The incidence of acarine infestation since its first appearance in 1925 is described. Maps show how greatly it spread between 1950 and 1955. Treating apparently healthy colonies in infected areas is recommended; orders relating to importation and migration should be supplemented; and all disease regulations should be supervised by the appointed veterinary surgeon.

FEILING, O. (1960) Méthode de lutte contre l'acariose en Hesse en vue de l'éradication de la maladie. [A method of acarine control in Hessen intended to eradicate the disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 3(1) : 9-28 [Fr, De, en, es, B, AA293/62]

Details are given (with 4 maps) of the distribution of the disease from 1900 to 1909. In Hessen acarine disease must be reported, and diseased colonies destroyed. Treatment and control measures are enforced in a zone 5 km round the site where the disease originated. Compensation is paid for destroyed colonies. Imported bees must have a health certificate.

FRANCE, MINISTÈRE DE L'AGRICULTURE (1960) Diagnostic de l'acariose; Traitement de l'acariose. [Diagnosis of acarine disease; Treatment of acarine disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 3(1) : 77-86 [Fr, B, AA290L/62]

Gives official instructions.

FROW, R.W. (1950) My beekeeping experiences. British Bee Journal 78(3540) : 273-274; (3541) : 289-290; (3542) : 305-307 [En, B, AA184/50]

Describes early experiences with acarine disease in England, and the first use, in 1927, of Frow's mixture (nitrobenzene, safrol and petrol).

HEJTMÁNEK, J. (1953) Cesty roztočovej nakazy na Slovensko. [Acarine disease in Slovakia.] Včelařstvi 1(1) : 11-12 [Sk, B, AA190/54]

In bees examined since 1934, acarine disease has never been found in the native bees of Slovakia; all the diseased colonies have been imported ones (such imports are illegal). The disease has now been confined to a small area, outside which the movement of bees - migratory beekeeping, sale of colonies and queens - is free throughout Slovakia. The danger of stray swarms introducing the disease from neighbouring countries is small: according to Ŏrŏsi-Pál, Hungary is free from it; in Poland it has been found in five counties, but the mountains form an effective barrier against stray swarms; the extent of acarine disease in Austria is not known.

JAYCOX, E.R. (1958) Acarine disease of honey bees. Bulletin of the California Department of Agriculture 47(3) : 215-221 [En, B, AA166/59]

The discovery and importance of the acarine mite is reviewed and details given of its life history, effects upon individual bees and the colony, distribution and diagnosis.

Biological, cultural, and chemical controls are discussed briefly in relation to their use in eradication of new infestations. A possible plan of eradication (in case of discovery of the mite in the United States) is presented, with emphasis on the need for State apiary laws written so that they would allow immediate action.

KIRKOR, S. (1958) Le cours de l'acariose en Pologne et les épreuves de la traiter. [Acarine disease in Poland and treatments used.] Pages 60-61 from "Proceedings of the XVII International Beekeeping Congress, Bologna-Rome, 1958" [Fr, En, De, It, B, AA430/58]

2.52 continued

Acarine disease was not found in Poland until 1950; it was then introduced from Czechoslovakia. Prompt action has kept infection to within an area 30 miles across. Treatment with mustard oil was the most successful. Thymol and BEF did not completely cure it, and the French Acarotoxin did not give good results.

KOCH, H. (1959) L'évolution de l'acariose en Belgique: influence de l'utilisation de la méthode P.K.
The full entry, with annotation, is in 2.21.

LENÁRTH (1951) S.O.S. Slovenských včelárov! [SOS of Slovak beekeepers.] Slovensky Včelár 29(5) : inner cover [Sk, B, AA170/52]
Acarine disease is reported to be spreading rapidly. In spite of 1946 laws forbidding from the import of colonies, swarms, queens, combs and beekeeping equipment from Czech territory to Slovakia, colonies and swarms have been smuggled in. It is recommended that sample of bees from suspect colonies must be sent for examination, and every beekeeper must report immediately any movement of hives or swarms in his own area.

LÖBER, W. (1966) Der Untertaunuskreis aus der Milbenperspektive. [The lower Taunus region from the point of view of acarine disease.] Biene, Giessen 102(1) : 11-16; (2) : 37-41 [De, B, AA708L/66]

MICHAEL, A.S. (1961) The Honeybee Act and the acarine problem. Gleanings in Bee Culture 89(8) : 492-494, 509 [En, B, AA628/63]
This Act (1922) restricts the importation of live honeybees into the US and is a preventive measure against adult bee diseases, particularly acarine. In 1947 further restrictions were imposed by amendments to the original law. The Department of Agriculture hoped to broaden the Act to restrict import of all Apis species. Recent intensive surveys throughout the US have not revealed the presence of acarine disease, but external Acarapis mites have been found on bees from most regions of North America. Other actions taken by the US Department of Agriculture to meet current problems related to the Honeybee Act are discussed.

MOMMERS, J. (1962) Mijtziekte (acariose). [Acarine disease.] Bijenteelt 64 : 130-131, 156-158, 163-165 [Nl, en, E708, B, AA626L/63]
Review, which includes distribution in the Netherlands.

MOMMERS, J. (1965) Die Milbenseuche in den Niederlanden. [Acarine disease in the Netherlands. Deutsche Bienenzeitung 16(4) : 94-96 [De, B, AA158L/66]

MORGENTHALER, O. (1930) Ein Versuchs - Bienenstand für Milbenkrankheit im Berner Seeland und einige dort gewonnene Ergebnisse. [An experimental apiary for acarine disease in Berner Seeland and a few of the results obtained there.] [De, B]

MORGENTHALER, O. (1931) Der Sieg über die Bienenmilbe. [Victory over the acarine mite.] Schweizerische Bienen-Zeitung 54(10) : 498-503 [De, B]

MORGENTHALER, O. (1934) Staatshilfe und Selbsthilfe bei der Bekämpfung der Milbenseuche in der Schweiz. [State help and self help in control of acarine disease in Switzerland.] Bienenvater, Wien 66(3) : 83-85 [De, B]

2.52 continued

MORGENTHALER, O. (1945) Die neue Situation in der Milbenbekämpfung. [The new situation in the fight against acarine.] Schweizerische Bienen-Zeitung 68(10) : 417-419 [De, B]

NIEMCZUK, R. (1974) Wystepowanie oraz zwalczanie akarozy (Acarinosis apium) w pasiekach dolnego slaska. [The occurrence and control of acarine disease in Lower Silesian apiaries.] Wiadomości Paraztyologiczne 20(6) : 881-885 [Pl, en]

SHAH, F.A.; SHAH, T.A. (1978) Control of acarine in the Kashmir valley. Indian Bee Journal 40(2) : 36-38 [En, B, AA236L/81]
Deals with Apis cerana.

ŠVANCER, L. (1963) How Slovakian apiarists control acarine disease. Summaries, XIX International Beekeeping Congress : 112-113 [En, B]

SVOBODA, J. (1951) Pomoc včelárskych krúzkov pri tlmeni roztocovej nákazy. [Beekeepers' Associations help in the battle against acarine disease.] Slovenský Včelár 29(4) : 62 [Sk, B, AA171/52]
One third of colonies are infested with acarine mites; more information is needed on large-scale treatment. Treatments with BEF and hydrochloric acid are described.

SVOBODA, J. (1960) Expériences sur le traitement de l'acariose. [Experiments on the treatment of acarine disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 3(1) : 59-72 [Fr, De, B, AA294L/62]
Describes methods in current use in Czechoslovakia.

WILLE, H. (1983) Die Bekämpfung der Acarapismilbe: Wie wird die Anzeigepflicht eingenhalten? [Control of Acarapis: how is the duty to report [an infestation] being observed?] Schweizerische Bienen-Zeitung 106(3) : 107-113 [De, B, AA923/84]
Animal health orders in Switzerland stipulate that beekeepers must report outbreaks of certain diseases, and if they suspect an Acarapis infestation they must submit a sample of bees for examination. In the period 1960-1964, a total of 23 655 samples were submitted (mites were identified in 2.7% of samples); in 1977-1981 only 2725 samples were submitted, and over one-third contained mites. Possible reasons for these figures are discussed.

2.53 BIOLOGICAL TREATMENT (INCLUDING COLONY MANAGEMENT)

GIORDANI, G. (1965) Technique d'isolement des abeilles accompagnatrices pour les expeditions de reines. [Technique for isolating worker bees sent with queens in postal cages.] Bulletin Apicole d'Information et de Documenatation Scientifique et Technique 8(1) : 69-70 [Fr, B, AA128/67]
The technique was devised to keep worker bees free from acarine disease pending their despatch with the queen. A small box or super without a flight entrance, and containing only sealed brood ready to emerge, is placed over a strong colony, separated from it by a double screen. Bees emerging in the box are kept warm by the colony below, and have honey and water, and so can stay shut up until they are needed.

2.53 continued

KAESER, W. (1952) Bekämpfung der Milbenseuche auf biologischer Grundlage. [Biological treatment of acarine disease.] Deutsche Bienenzeitung 3(2) : 21-25 [De, B, AA131/52]

The method is based on the removal of diseased brood. The operation, lasting 4 months, was successful.

KAESER, W. (1954) Aus der Arbeit des Freiburger Instituts.

The full entry, with annotation is in 2.21.

LAVIE, P. (1951) Investigations on a mysterious micro-organism, Acaromyces laviae, which appears to be a parasite of Acarapis woodi.

The full entry, with annotation is in 2.43.

LAVIE, P. (1952) Premiers résultats obtenus dans les essais de traitement de l'acariose au moyen de l'acaromyces.

The full entry, with annotation is in 2.43.

LEIPZIGER BIENENZEITUNG (1958) Biologische Kontrolle der Milbenseuche. [Biological control of acarine disease.] Leipziger Bienenzeitung 72(7) : 197-201 [De, B]

Mentions use of an ice pack at the entrance to keep bees in the hive.

MARTINEK, J. (1982) Lze chránit včelstva před roztočíkovou nákazou chovateskými zásahy. [Should honeybee colonies be protected against acarine disease by using rearing principles?] Včelařství 35(3) : 65-66 [Cs, B]

MORGENTHALER, O. (1965) Die natürlichen Widerstände gegen eine rasche Ausbreitung der Milbenseuche im Bienenvolk. [Natural prevention of the rapid spread of acarine disease.] Vědecké Práce Vyzkumného Ustavu Včelařského v Dole u Libčic 4 : 131-136 [De, en, cs, fr, ru, B, AA160/66]

Those aspects of the life history of the acarine mite are discussed which provide protection against the disease in broodless periods. They also provide a basis for mechanical methods of acarine control.

SVOBODA, J. (1947) The mechanical eradication of acarine disease. Bee World 28(5) : 41-43 [En, B]

Removing brood combs.

SVOBODA, J. (1958) Tlumení roztočové nákazy. [Treatment of acarine disease.] Vědecké Práce Vyzkumného Ustavu Včelařského v Dole u Libčic 1 : 15-42 [Cs, en, de, ru, B, AA169/64]

Various chemical and biological methods are described and evaluated. BEF is recommended as a chemical treatment; biological control can give complete success, but is very laborious.

2.6 CHEMICAL METHODS OF CONTROL

The entries in this section are numbered (a1, a2, ...), and are indexed under chemical and trade names in Section 5. Publications relating to the most commonly tested agents are entered first, under a familiar name (2.61-2.67), and then reports on other agents and general papers in a single sequence (2.68).

a1 BÜDEL, A. (1953) Rauch in der Wabengasse. [Smoke among the combs.] Südwestdeutscher Imker 5(1) : 14-16 [De, B, AA187/54]

An attempt was made to determine whether smoke disturbed the temperature balance inside a hive, especially in the brood nest. Using combs containing thermocouples, in an experimental hive, it was shown that the bees kept the temperature of the brood nest constant; although very bad weather occurred immediately after the smoke was used and the outside temperature fell to -7°C, readings taken next day showed that the whole balance of their microclimate in the hive had been restored. The weather prevented the bees from removing any dead ones, and it could thus be verified that there were no deaths due to the smoke.

a2 KOCH, H. (1961) Un appareil simple pour insuffler de la fumée acaricide dans les ruches. [A simple apparatus to blow acaricide smoke into the hive.] Belgique apicole 25(5) : 113-115 [Fr, B]

a3 LAERE, O. VAN; WAEL, L. DE; WEGHE, L. VAN DE (1982) Eine Vorrichtung zum medikamentosen Rauchern von Bienenvolkern. [A device for smoking colonies for disease control.] Allgemeine Deutsche Imkerzeitung 16(1) 6-7 [De, B, AA599/83]

A plan shows the design of the apparatus which is based on the smoker described by Koch [1956] for treating colonies with acarine disease. The advantage of the modified smoker described here is that normally it is not necessary to blow air in, and thus the smoke is quite concentrated.

a4 MERRILL, J.S. (1959) Antibiotics and drugs for acarine disease: selected references. Beltsville, OH, USA : USDA 2 pp. [En, B, AA688L/62]

a5 PEREPELOVA, L.I.; SAMYSHKINA, V.S. (1969) [Combating acarine disease of honeybees.] Moscow, USSR : Rossel'khozizdat 60 pages 2nd ed. [Ru, B, AA165L/72]

2.61 BEF (BENZENE ETHYL FORMIATE)

a6 PAIKERT, F. (1958) Chemotherapie roztocove nakazy. [Chemical treatment of acarine disease.] Vědecke Práce Vyzkumného Ustavu Včelařskeho v Dole u Libčic : 181-191 [Cs, en, de, ru, B, AA170/64]

In 1951-56 various chemicals were tested, on both the respiratory and digestive tracts. The most successful were BEF and Folbex, and BEF could completely cure acarine disease. No feeding method was successful: infusion of garlic, and decoctions of *Artemesia* and *Chrysanthemum* were tested.

a7 SKROBAL, D. (1958) Expérimentation avec les traitements en masse d'acariose a l'aide de BEF. [Experiments on mass treatment of acarine disease with BEF.] Pages 119-120 from "Proceedings of the XVII International Beekeeping Congress, Bologna - Rome, 1958" [Fr, En, De, It, B, AA431/58]

2.61 continued

The history of acarine disease in Czechoslovakia is given. Other treatments have not proved effective, but the use of BEF has reduced the incidence from 31% to 1.7% where it has been used on all the colonies in a district. Six doses are found necessary, over a period of 2 years.

a8 SLEZÁK, V. (1959) Léčivo BEF proti roztočové nákaze. [The treatment of acarine disease with BEF.] Včelařství 12(3) : 40-41 [Cs, B, AA67/61]
As a result of incorrect treatment with the Swiss preparation Folbex (every second day instead of once a week), the bees seemed excessively irritable and killed all the queens. The application of Folbex before the spring is not recommended. Treatment with Folbex at the Czech institute at Dol for 2 months (8 weekly intervals) also excessively irritated the bees. Acarine disease is experimentally shown to be successfully treated with BEF, the objection to which is its high price.

a9 SVOBODA, J. (1950) Podzimni leceni roztocove nakazy vcel pripravkem BEF. [Winter treatment of acarine disease with BEF.] Vcelar 84(10) : 146-147 [Cs, B, AA172/52]
The compound is still undergoing trials. Treatment should begin a week after feeding for the winter, and the liquid should evaporate at a rate of 100 ml in 20 days. Up to 80% of mites die within 2 weeks, and repeated treatment is necessary to clear the tracheae of all bees.

a10 SVOBODA, J. (1951) Léceni roztocové nákazy. [Treatment of acarine disease.] Včelar 4(8) : 172-173 [Cs, B, AA19/53]
BEF was found to be efficient for large scale treatment of bees in various types of hive. In tests with hydrochloric acid, brood was seriously damaged, and in some colonies the queen was killed.

a11 SVOBODA, J. (1958) Tlumení roztočové nákazy.
The full entry, with annotation is in 2.53.

2.62 DICOFOL (KELTHANE)

a12 LAERE, O. VAN (1960) De bestrijding der bijenacariose bij middel van Keltane. [Control of acarine disease of honeybees with keltane [dichlorophenyl trichloroethanol].] Mededelingen van de Landbouwhoogeschool en der Opzoekingsstations van de Staat te Gents 25 : 1315-1320 [Nl, en, fr, de, E555, B, AA181/63]
A preparation with a sawdust base, containing kelthane and potassium nitrate, was used. In a laboratory experiment all acarine mites were killed within 30 min. Two infested colonies were treated at the end of March with 5 fumigations at 6-day intervals; the results appear promising.

a13 SKRYPNIK, E.I. (1975) [Acaricides and the spring treatment of bees.] Veterinariya, Moscow, USSR No. 6 : 79-80 [Ru, AA564/78]
The percentage of infested bees in colonies attacked by A. woodi averaged 14.3 in February and 6.5 in March; the difference was attributed to death of overwintered bees after spring emergence. The proportion of mites at various stages of development varied through the year. Aerosols of Aramite [2-chloroethyl 2(4-(1,1-dimethylethyl)phenoxy)-1-methylethyl sulphite] at 6, 8 and 12 g active ingredient/m^3, tetradifon (Tedion) at 10, 14 and 16 g/m^3 and dicofol (Kelthane) at 6-10 g/m^3 were harmless to bees even with 10 or more treatments. Aramite killed 93.8%

2.62 continued

of adult mites; dicofol, 82.7%; phenkapton, 87.5%; Sulphenone [1-chloro-4-(phenylsulphonyl)benzene], 80%; tetradifon, 71% and chlorfenson, 70%. The effectiveness of the acaricide varied with time of year, being lowest in late autumn. The most effective acaricide and the least toxic to bees of those tested was tetradifon, followed by dicofol. Thermal aerosols of tetradifon, dicofol, chlorobenzilate (Folbex) and chlorfenson were repellent to mites, and were used to prevent infestation of young bees in spring.

2.63 FOLBEX (CHLOROBENZILATE)

a14 ADLAKHA, R.L. (1976) Acarine disease of adult honey bees in India.
The full entry, with annotation, is in 2.21.

a15 ALEKSEENKO, F.M. (1973) [Effectiveness of chemical treatments during acarine disease of honeybees.]
The full entry, with annotation, is in 2.22.

a16 ATWAL, A.S.; SHARMA, O.P. (1970) Acarine disease of adult honeybees: prevention and control.
The full entry, with annotation, is in 2.45.

a17 ATWAL, A.S. (1967) Acarine disease problem of honey bees in the Punjab.
The full entry, with annotation, is in 2.21.

a18 ATWAL, A.S. (1971) Acarine disease problem of the Indian honey bee, Apis indica F.
The full entry, with annotation, is in 2.13.

a19 BAILEY, L.; CARLISLE, E. (1956) Tests with acaricides on Acarapis woodi (Rennie). Bee World 37(5) : 85-94 [En, B, AA357/57]
Tests under various conditions indicated that Ovotran and chlorobenzilate were the most effective. Treatment is not recommended during very hot weather, when there is a heavy nectar flow, or when bees are tightly clustered. Warm weather in early summer, before the main nectar flow, seemed to provide the most suitable conditions; one application was sufficient to suppress infection, and two to eliminate it if applied annually. The apparent value of Frow's mixture seemed to be offset by a higher mortality of bees.

a20 BAILEY, L.; CARLISLE, E. (1955) Trials with acaricides at Rothamsted. Bee World 36(1) : 14 [En, B, AA221/56]
Acaricides were applied to acarine-infested colonies, in the form of smokes generated by smouldering paper strips. The dose for a colony in one B.S. National hive body consisted of 400-450 mg of pure acaricide (Dimite, Ovotran, Chlorparacide, or P.C.P.B.S.); all these substances killed very highly significant numbers of adult mites, with no significant effect upon their eggs and larvae, except that with Ovotran the total number of acarine larvae per bee rapidly diminished (usually to zero) 2 days after treatment, the eggs possibly being killed. Frow's mixture and sulphur smoke had no effect. Dimite and chlorobenzilate appeared non-toxic to bees, whereas double doses of Ovotran and Chlorparacide, and single doses of P.C.P.B.S., were significantly toxic. In spite of cold weather all acaricides reduced infestations of most colonies to zero after 5 treatments

2.63 continued

a21 CORREVON, A. (1955) Lutte contre l'acariose. [Control of acarine disease.] Journal Suisse d'Apiculture 52(7) : 198-201 [Fr, B, AA210/57]

A piece of apparatus is described and illustrated for use when treating acarine disease with Folbex, to minimize danger of fire.

A tube is closed above by a cork; from it hangs a hook on which can be suspended a piece of blotting paper impregnated with Folbex. Below, the tube has a grille and prongs, so that it can be secured to the alighting board. A junction at the level of the hook allows the attachment of a pipe whose end has numerous small holes. This end is passed through the hive entrance which is otherwise closed with cotton wool.

a22 GUBLER, H.U. & OTHERS (1953) Ueber ein neues spezifisches Mittel zur Bekämpfung der Bienenmilben. [A new specific remedy for controlling the acarine mite.] Schweizerische Bienen-Zeitung 76(7) : 268-272; also in Journal Suisse d'Apiculture 50(7) : 193-197 [De, Fr, B, AA24/54]

Results of trials with chlorobenzilate showed that it is suitable for treatment of colonies during the active season, but not in the winter. Five applications per colony, at weekly intervals, are recommended, and during treatment the bees are shut in the hive for 1 hour.

a23 HIRSCHFELDER, H. (1957) Die Chemotherapie der Milbenseuche. [Chemical treatment of acarine disease.] Archiv für Bienenkunde 34(1) : 49-54 [De, B, AA87/59]

The author gives a short survey of the historical development of the chemotherapy of acarine disease. In his own investigations mustard oil was highly effective, but also very susceptible to disturbance. The acaricides PK and Folbex were particularly good, but treatment must be carried out 8 times in 7 weeks. These means could make it possible for the mite to be exterminated in a given area, provided that beekeepers in that area could be induced to use them as directed.

a24 INDIA. INDIAN STANDARDS INSTITUTION (1977) Specification for [chlorobenzilate] fumigant strips for treatment of honey-bees.

The full entry, with annotation, is in 2.45.

a25 KREHMER, E. (1970) Milbenseuche der Bienen und seuchenhygienische Massnahmen - Folgerungen aus einer Reihenuntersuchung. [Acarine disease and hygienic measures: conclusions from long-term investigations.] Tierärztliche Umschau 25(9) : 430, 433-437 [De, B, AA201/74]

Sample figures for the occurrence of acarine disease during 1968 and 1969 were similar to those for the period 1963-67. The present method of examining samples of bees dying in winter and treating the infected colonies is unsatisfactory and not sufficiently effective. General treatment with Folbex, in regions where the disease occurs, is recommended.

a26 SAMYSHKINA, V.S. (1960) [Investigation of remedies for acarine disease of bees.] Pchelovodstvo 37(6) : 45-48 [Ru, B, AA855/63]

The best results (100%) were obtained with Folbex and Frow mixtures. Nitrobenzol, methyl salicylate and BEF were only partly effective.

a27 SAMYSHKINA, V.S. (1966) [An experiment in treating apiaries in the Ryazan and Moscow regions against acarine disease.] Pages 180-182 from "Achievements of science and advanced experiment in beekeeping" ed. A.E. Feferman, Moscow : Rossel'khozizdat [Ru, B, AA547/69]

2.63 continued

At the "Alad'ino" state farm in Ryazan region, 122 out of 233 colonies showed evidence of mites. Treatment consisted in the application of ether sulphonate during May and June. Smoke from the medicament was introduced into the hive by means of a reconstructed smoker, and treatment was given eight times at 6-day intervals. The number of affected colonies after this treatment was reduced to 15. The following year Folbex strips were used for treatment and the disease was completely eradicated. In "Kudinovo" state farm, Moscow region, the apiary was 40% infected. Here, Folbex strips were given eight times (every 6 days). All the colonies recovered. The treatment went hand in hand with compulsory zootechnical measures: replacement of queens in affected colonies, feeding of the bees with small amounts of sugar syrup, precautions taken to prevent drifting, etc.

a28 SCHNEIDER, H. (1959) Die Milbenbekämpfung mit Folbex. [Treatment of acarine disease with Folbex.]
The full entry, with annotation, is in 2.21.

a29 SMIRNOV, A.M. (1976) [Prophylaxis of infestation with Varroa and Acarapis mites: methods of treatment.] Pchelovodstvo 94(7) : 27-30 [Ru, B, AA1137/76]
Hives with acarine disease and neighbouring apiaries are put into quarantine, and neither they nor queens may be sold. Chemical control is by Folbex, Tedion (tetradifon), ethyldichlorbenzilate or "Ethersulphonide" [ether sulphonate?].

2.64 FROW'S MIXTURE

a30 FROW, R.W. (1933) Verbesserungs - Vorschläge für die Frow - Behandlung. [Suggestions for the improvement of the Frow treatment.] Schweizerische Bienen-Zeitung 56(9) : 476-484 [De, B]
(The first attempt, in 1927, to use the nitrobenzene + safrol + petrol mixture to kill mites is described by Frow (1950); see 2.52.)

a31 ILLINGWORTH, L. (1929) Das Frow'sche Heilmittel gegen Milbenkrankheit. [The Frow treatment for acarine disease.] Archiv für Bienenkunde 10(7) : 226-229 [De, B]

a32 LAVIE, P. (1950) Nouvelles recherches sur le traitement de l'acariose. Notes préliminaires.
The full entry, with annotation, is in 2.41.

2.65 M1045

The active ingredient of M1045 is p-chlorobenzyl p-chlorophenyl sulphonate.

a33 FRITZSCH, W. (1960) Untersuchungen zur Entwicklung und Erprobung eines Heilmittels für die Bekämpfung der Milbenseuche in der Deutschen Demokratischen Republik. [Development and testing of a treatment for acarine disease in the DDR.] Monatshefte für Veterinarmedizin 15(21) : 763-768 [De, B, AA377/64]
Successful experiments are described in which M1045 was used on fumigating strips instead of Folbex strips.

2.65 continued

a34 FRITZSCH, K.; FRITZSCH, W. (1961) Zur Entwicklung, Erprobung und Anwendung eines neuen Heilmittels gegen die Milbenseuche in der DDR. [Leipziger Bienenzeitung 75(6) : 181-184 [De, B, AA456/61]

This fumigation treatment was tried out on small experimental colonies for damage to bees, and then on larger colonies, with which it gave good results in controlling acarine infestation when the directions were carefully followed. It is used in the spring, when brood in all stages and unsealed stores are present. It is useless to try to save weak colonies, or those badly infected with *Nosema*.

a35 FRITZSCH, W. (1969) [A miticide for use particularly against *Acarapis woodi*.] German Democratic Republic Patent 69 967 : 2 pp. [De, AA920L/73]

p-Chlorophenyl p-chlorobenzenesulphonate used as a smoke.

2.66 MENTHOL

a36 KSHIRSAGAR, K.K.; SALVI, S.R.; MAHINDRE, D.B.; CHAUHAN, R.M. (1983) Menthol as an effective acaricidal fumigant.

The full entry, with annotation, is in 2.45.

a37 LEPORATI, M.; GIORDANI, G. (1982) Controllo in campo dell'acariosi delle api con mentolo. [Control of acarine disease of honeybees with menthol.] Rome, Italy : Federazione Apicolturi Italiani 24 pp. [It, B, AA1264/83]

Menthol crystals or a solution of 20 g menthol in 100 ml or 80 ml alcohol were effective against *A. woodi*. Results of tests using various treatments on colonies with different levels of infestation are reported.

a38 VECCHI, M.A.; GIORDANI, G. (1967) Research on chemotherapy of *Acarapis woodi* Rennie. 1. Laboratory tests. Abstracts, XXI International Beekeeping Congress No. 43 : 69-70 [En, B, AA753/67]

Of the substances tested that are volatile at ordinary temperatures, the only one effective against *A. woodi* in the honeybee was menthol in crystal form, in a 10% alcohol solution, or mixed with vaseline in the proportion 1:2. There was a definite correlation between the average rate of evaporation of the menthol and its acaricidal effect. Menthol exerts its greatest effect on adult mites within 72 h, the mortality ranging from 90 to 100%; the average mortality of immature stages was about 60%. The young stages survive longer when they are in the upper respiratory ducts and the head, or when the tracheae are heavily infested. Treatment in a controlled environment for at least 90 h with a consumption of about 4 g menthol, is recommended for eliminating adult mites; it also has an appreciable effect on young stages, especially with light infestations.

a39 VECCHI, M.A.; GIORDANI, G. (1968) Chemotherapy of acarine disease. 1. Laboratory tests. Journal of Invertebrate Pathology 10(2) : 390-416 [En, B, AA157/69]

In cage tests with honeybees infested with *A. woodi*, only menthol gave consistently good control. It was more effective against adult mites than against immature stages. The success of treatments was related to the intensity of initial evaporation. Crystalline, solvent and ointment formulations of menthol were tested at different dosages and for different lengths of time under various conditions against various degrees of infestation.

2.66 continued

Other chemicals tested included cade oil, Dermovete (rotenone and cade oil in an alcohol-acetone medium), eucalyptol, gomenol, Oleobalsamina (a liquid containing juniper spirit, salicylic acid, methyl salicylate, essence of eucalyptus, camphor oil and creosote), Rinosan (a compound based on camphor, menthol, thymol, pine oil, gomenol, chloretone and ephedrine) and terpineol.

2.67 PK

The active ingredient of PK is 1,1-bis(4-chlorophenyl)ethanol.

a40 BOSELLI, F.B. (1953) Relazione sullo esperimento ufficiale contro l'acariosi delle api eseguito nell' apiario Arba a S. Basilio, Cagliari, nel marzo-aprile 1953. [Official experiment on the control of acarine disease...] Apicoltore d'Italia 20(12) : 273-276 [It, B, AA245/55]

In a Sardinian apiary of 120 colonies in skeps, only 12 were of normal strength. The rest had acarine disease; they were treated with PK and all except 7 recovered.

a41 GIORDANI, G. (1956) Experimenti comparativi di lotta contro l'acariosi delle api con diversi acaricidi. [Comparative experiments in treating acarine disease with various acaricides.] Archivio Veterinario Italiano 7(1) : 25-42 [It, B, AA292/62]

Comparative experiments were conducted with Mito A_2, PK, Acarotoxine and Folbex, on a large number of colonies under various climatic conditions. Folbex has so far proved best and was particularly effective in southern Italy. Mito A_2, which was effective in central Italy, was much less useful. PK appeared useless in any environment; Acarotoxine was only used on a small scale in central Italy.

Detailed data are given for all tests, and results are discussed in relation to those obtained by other workers.

a42 KAESER, W. (1952) Untersuchungen zur Widerstandsfähigkeit der Innenmilbe (Acarapis woodi) der Honigbiene und zur Möglichkeit ihrer Bekämpfung. [The resistance of the internal mite of the honeybee and the possibility of its control.] Zeitschrift fur Bienenforschung 1(10) : 191-216 [De, E117, B, AA286/53]

Various chemicals - including mustard oil, colloidal sulphur and terpineol - were fed in syrup to infested bees, but there were no noticeable effects on the mites. Mites on glass slides, and in diseased bees in cages and in diseased colonies were treated with Frow's mixture, many mustard oil preparations, methyl salicylate, sulphur smoke, terpineol; they were either ineffective or damaged the bees as well as the mites.

A Belgian preparation PK gave better results, and Delacan is claimed to have been the most effective. The number of live mites was reduced to nearly zero in 15-28 days in several hundred colonies after later winter and early spring treatment with Delacan.

a43 KOCH, H.; DELVAUX, E.; GRÉGOIRE, C. (1952) Un espoir de lutte efficace contre l'Acarapis woodi, agent causal de l'acariose des abeilles. [A hope of efficacious control of Acarapis woodi.] Belgique Apicole 16(3) : 45-47 [Fr, B, AA220/56]

This paper gives the chemical background to the successful experiments described by de Meyer in the treatment of acarine disease. PK, the substance used in the experiments, was the acaricide Dimite, which was found to be harmless (even stimulative) to bees.

2.67 continued

a44 KOCH, H.J. (1955) La lutte contre l'acariose des abeilles. Procédé PK. Une mise au point. [Control of acarine disease: PK method.] Belgique Apicole 19(4) : 84-92 [Fr, B]

a45 KOCH, H. (1959) L'évolution de l'acariose en Belgique: influence de l'utilisation de la méthode P.K.
The full entry, with annotation, is in 2.21.

a46 LAERE, O. VAN; GILLARD, A. (1954) Onderzoekingen over de verspreiding en de bestrijding van de mijtziekte der honingbij.
The full entry, with annotation, is in 2.21.

a47 MEYER, E. DE (1952) L'acariose des abeilles est vaincue. [Acarine disease is conquered.] Belgique Apicole 16(1/2) : 17-19 [Fr, B, AA39/53]
In the winter of 1950-51 34 colonies infested with A. woodi, some heavily, were treated with a substance known as PK of undisclosed composition, prepared by Henri Koch, Professor of Zoology at Louvain University. Three weeks later microscopic examination showed all colonies to be free from disease, and further tests after 3 months were also negative. It is claimed that PK is harmless to brood, honey and pollen, and can therefore be administered at any time of year either for treatment or prevention of the disease. PK is provided in crystalline form on corrugated paper, and it is administered in smoke. The author suggests that all hives within flight range of an infested one should be treated prophylactically. Further experiments are being made to investigate the possible stimulative effect of PK.

a48 MEYER, A. DE (1952) L'effet stimulant des PK. [Stimulative effect of PK.] Belgique Apicole 16(7) : 179-180 [Fr, B, AA40/53]
The author observed 3 colonies treated for acarine disease with PK, 2 diseased and one treated prophylactically. He concluded that PK has a marked stimulative effect, which is observed throughout the season if the colonies are treated early. Researches are continuing into the minimum quantities of PK needed for stimulation. As a result of the present observations it is recommended that preventive treatment of acarine disease should be carried out in late July or early August, in order to avoid undesirable autumn stimulation.

a49 ROUSSEAU, M. (1955) Expériences de traitement de l'acariose par le P.K. et le Folbex. [Treatment of acarine disease with P.K. and Folbex.] Abeilles et Fleurs (26/27) : 9-10, 10-11 [Fr, B, AA25/57]
The first paper is 'Résultats de l'application des méthodes de traitement de l'acariose avec le Folbex', and the second 'Expériences de traitement de l'acariose par le P.K.'. The first paper is also published in Apiculteur 99(9) : 152-155.
Experiments with caged bees and colonies led to the following conclusions. PK is effective, if treatment is given once a week for 4 weeks; it should be repeated the next spring, and samples of 50-100 bees examined from each colony each spring and autumn for 2 years. Eight weekly treatments are necessary with Folbex (May-August only), with a repetition next year; subsequent examination of sample bees should be made as for PK.

a50 SCHYNS, P. (1962) Résultats contrôlés du traitement de l'acariose des abeilles par le P.K. et les progrès réalisés en Belgique dans la lutte contre cette maladie. [Results of the treatment of acarine disease with PK

2.67 continued

and progress made in Belgium in the control of this disease.] Bulletin Apicole d'Information et de Documentation Scientifique et Technique 5(1) : 58-66 [Fr, en, de, es, B, AA169/65]

Preliminary experiments with this treatment gave extremely good results, but only if it was carried out accurately and with great care. The disease was definitely eliminated after 8 fumigations at specified intervals early in the season.

2.68 OTHER AGENTS

a51 BIENENVATER (1950) Ergebnis eines Erfahrungsaustausches über die Milbenseuchenbekämpfung. [Results of experiments on the treatment of acarine disease.] Bienenvater 75(4) : 113 [De, B, AA146/50]

Experiments with preparations of mustard oil have been tried out in several places in Germany and Austria. In laboratory tests they have been found to kill the mites and to be harmless to bees and brood. It is suggested that they should be used in spring when the sallow (Salix sp.) is in bloom, in summer when bad weather keeps the bees in the hive, and in autumn after winter feeding but before the winter cluster is formed.

a52 CLINCH, P.G.; FAULKE, J. (1977) Toxicity to the external mite Acarapis externus Morgenthaler of pesticides fed in sugar syrup to infested honey bees.

The full entry, with annotation, is in 4.12.

a53 CZARNECKI, J.-M. (1984) Contribution à l'étude du traitement de l'acariose à Acarapis woodi R. de l'abeille domestique Apis mellifica spp. à l'aide de l'ester isopropylique de l'acide 4,4'-dibromobenzilique. [Contribution to study of the treatment of Acarapis woodi infestations of the honeybee with isopropyl-4,4'-dibromobenzilate.] Thèse Dr.-Vet., Université Paul Sabatier de Toulouse, France : xiii + 212 pp. [Fr, B]

a54 DEANS, A.S.C. (1955) Dichlorobenzoic acid in the treatment of acarine disease. Scottish Beekeeper 31(2) : 21-23 [En, B, AA196/56]

Experiments were carried out in August/September 1954 as follows. Smoke strips were prepared by soaking corrugated paper in 10% saltpetre solution and then drying; 2-4 dichlorobenzoic acid (1 g per dose) was spread on the paper which was then rolled up, ignited and placed in a container (method 1) or on a piece of tin placed on top of the frames, with an empty shallow super added (method 2). Treatment was given when bees were not flying, and the entrance was closed for 15-20 min.

The percentage infestation was considerably reduced, but live mites were found in some bees.

Results of treatments given at weekly intervals (3 or 5 treatments) in April-May 1954 suggest that even a weak colony can clear itself of infestation under treatment.

a55 DINABANDHOO, C.L.; DOGRA, G.S. (1979) Dichlorvos for the control of acarine disease of Indian honey bee, Apis cerana Fab.

The full entry, with annotation, is in 2.45.

a56 DINABANDHOO, C.L.; DOGRA, G.S. (1983) The acarine induced decline in Indian honeybee Apis cerana indica L. and its control in Kulu valley.

The full entry, with annotation, is in 2.45.

2.68 continued

a57 FIALA, F. (1950) Léceni roztocové nákazy kyselinou solnou. [Treatment of acarine disease with hydrochloric acid.] Vcelar 84(10) : 148-149 [Cs, B, AA173/52]

After preliminary trials with some hundreds of colonies, success is claimed for the autumn treatment of acarine disease with hydrochloric acid. The acid (6-12 ml, specific gravity 1.4-1.5) is given every 4 days in a shallow glass tray, or on a felt pad 100 x 100 x 5 mm on a glass plate, pushed in under the brood frames and renewed 3-4 times (every 8-9 days).

Large-scale tests are now in progress, and records provided on questionnaires completed by beekeepers who use the treatment will be evaluated statistically.

a58 FREDIANI, D. (1974) Prove d'impiego del tetraclorodifenilsulfone nella terapia dell'acariosi delle api. [Use of tetrachlorodiphenyl sulphone in the treatment of acarine disease.] Agricoltura Italiana, Pisa, Italy 74(3/4) : 215-219 [It, en, B, AA1287/77]

Of 20 colonies in primitive hives, with 22-98% acarine infestation, 15 were treated with tetrachlorodiphenyl sulphone by Skrypnik's fumigation method. Treatment was repeated 5 times, on alternate days. In the control colonies infestation continued at 21-75%. In none of the treated colonies was it more than 4% and 17%, one month and one year respectively after the final treatment; many of the colonies showed no infestation.

a59 GIORDANI, G. (1973) Ricerche di laboratorio su Acarapis woodi Rennie agente della acariosi delle api mellifiche (Apis mellifera L.). Nota VII. [Laboratory investigations on Acarapis woodi, the agent of acarine disease in honeybees. Note 7.] Redia 54 : 141-151 [It, en, E1388, B, AA807/75]

The standard method of fumigation by burning impregnated strips was used to treat heavily infested colonies. The strips were impregnated with (a) Fundal SP (chlordimeform) or (b) chlorobenzilate, for comparison; (a) was slightly better than (b) in killing adult mites, and considerably more effective in killing eggs and larvae. During treatment with (a) many bees gathered on the hive floor, but they recovered when the ventilation was improved. The toxicity of Fundal to honeybees was comparable with that of chlorobenzilate.

a60 INGOLD, G.A. (1950) The treatment of acarine disease with sulphur fumes. Agriculture 57(1) : 35-38 [En, B, AA88/50]

Trials with sulphur smoke treatmemt, originally suggested by Rennie in 1927, gave encouraging results. Corrugated paper, treated with saltpetre and a glue-sulphur paste, was burned in the smoker, three puffs of dense smoke being given in the evening for 10 successive days, followed by a further 10-days' treatment after a 7-day interval. Treatments were carried out in the active season, and samples showed control of mites both 3 weeks after treatment and in the next spring.

a61 KAESER, W. (1952) Die Bekämpfung der Milbenseuche durch chemische Mittel. [The chemical control of acarine disease.] Deutsche Bienenwirtschaft 3(6) : 108 [De, B, AA130/57]

The smoke from small rolls of paper which had been impregnated with Delacan (a commercial preparation 1022/E3, composition not given) was blown into hives infested with acarine disease (in spring). Two or three treatments cleared up the disease, and there were no apparent ill effects on the bees.

2.68 continued

a62 KAESER, W. (1954) Aus der Arbeit des Freiburger Instituts.
The full entry, with annotation, is in 2.21.

a63 KOSTECKI, R. (1976) Untersuchungen über die Anwendung von Thymol bei der Behandlung der Milbenkrankheit der Bienen während der Überwinterungszeit. [Investigations on the use of thymol in the treatment of acarine disease of honeybees during overwintering.] Tierärztliche Umschau 31(9) : 398-401 [De, B, AA568/80]
Thymol, preferably 10-15 g on a Petri dish, was put into each hive in September, and kept moist until the following April. No harmful effects on bees were observed. In summer, thymol was supplied from April to the end of May (i.e. before the summer flow, to avoid contamination of honey). This extended treatment was effective in combating the disease.

a64 LEOPOLD, O (1950) Die Waffen schärfen zur nächsten General-Offensive gegen die Milbe! [Sharpen your weapons for the next general offensive against acarine!] Bienenvater 75(7) : 197-198 [De, B, AA190/50]
The use of Mito A_2 as advised by Dr Jordan of Vienna is recommended. The first step in spring is to feed each colony with two combs of sugar syrup so that they are stimulated and fly out. This gets rid of the old and badly infected bees into whose spiracles the Mito A_2 vapour would not penetrate properly. Then a small bottle of the Mito A_2 is put in, about the time that sallow (Salix sp.) blooms, and it is renewed as it becomes empty. If necessary the syrup feeding can be done during bad weather in the summer to get rid of more infected bees, and the bottle renewed afterwards. A final one can be put in in October. [Mito A_2 = 98% methyl alcohol + 2% mustard oil.]

a65 MARIN, M. (AND 5 OTHERS) (1975) Medicament destinat combaterii acariozelor la familiile de albine şi procedeu de obţinere a lui. [Composition for treating mite diseases of honeybees and method for preparing it.] Romanian Patent No. 63434 : 3 pp. [Ro, B, AA963/80]
A composition for the control of mites on honeybees consists of 0.5% sodium pyrosulphite, 0.272% of an 8% solution of 2,4,4',5-tetrachlorodiphenylsulphone, 0.15% of a 50% solution of isopropyl-4,4'-dibromobenzilate, 0.075% of a 50% solution of 2-methyl-4-chlorophenyldimethylformamide, 0.5% of a 25% solution of isopropyl-4,4'-dichlorobenzilate, and sugar. The composition controlled V. jacobsoni and A. woodi on honeybees.

a66 POLJAKOV, A.A. (AND 9 OTHERS) (1978) Akarizides Präparat zur Diagnostik und Bekämpfung von Ektoparasiten der Bienen. [Acaricide preparations for the diagnosis and control of ectoparasites of honeybees.] German Federal Republic Offenlegungsschrift No. 2719722 : 16 pp. [De, B, AA1170/80]
N-methylcarbamates control infestation of honeybees by A. woodi and by V. jacobsoni. Thus, application to hives of a composition containing 0.025% by weight methyl-N-methylcarbamate, 19.975% acetone, and 80% difluorodichloromethane, completely controlled these mites. The compounds are also useful for diagnosis, since their application to infested bees led to the appearance of dead V. jacobsoni on the bottom of the hive.

a67 RITTER, W. (1982) Möglichkeiten der Behandlung von Bienenvölkern gegen die Varroatose unde Milbenseuche. [Possible methods for treating honeybee colonies against Varroa and acarine disease.] Pages 70-83 from "Tagung der Fachgruppe Tierseuchenrecht. Giessen, vom 18-19 März, 1982", Giessen, German Federal Republic : Deutsche Veterinarmedizinische Gesellschaft e.v. [De, B, AA600/83]

2.68 continued

Folbex-VA-Neu is applied as a smoke to kill parasitic mites. It was used on a total of 2600 honeybee colonies without harming adult bees or brood. For treatment of acarine disease, a colony should be smoked with the substance 6 times within 7 days in early spring.

a68 RITTER, W.; PERSCHIL, F.; CZARNECKI, J.M. (1983) Treatment of bee colonies with isopropyl-4,4-dibromo-benzilate against varroa disease and acarine disease. Zentralblatt für Veterinärmedizin, B 30 : 266-273 [En, de, es, fr, B, AA280/84]

In field trials, fumigant strips containing isopropyl-4,4-dibromobenzilate (Folbex-VA) were burned in test hives (total 2600 hives) in the evening when foragers had returned. Bee mortality (workers and queens), behaviour and brood rearing were normal. A. woodi infestations were eliminated completely in spring by 6 applications of one fumigant strip per colony at intervals of 7 days. V. jacobsoni infestations were reduced by 97% in autumn with 4 applications of one strip per colony at intervals of 4 days. In laboratory tests Folbex-VA was significantly more toxic to V. jacobsoni, but less toxic to A. woodi, than chlorobenzilate (Folbex); it was also much less toxic to honeybees. It is recommended that Folbex-VA should be burned in an empty upper chamber (provided to allow the bees more space during the treatment). Food should be available e.g. uncapped honey or syrup, and the external temperature should be above freezing, but below 10°C.

a69 SAMYSHKINA, V.S. (1967) [Solving the problem of acarine disease in honeybees.] Trudy Nauchno-issledovatel'skogo Instituta Pchelovodstva : 234-251 [Ru, B, AA1018/72]

Various preparations were tested for curative or prophylactic properties. Ether sulphonate (Ovex), applied as a vapour, showed most promise, particularly when administered in spring.

a70 SCHMID, W.J. (1982) International experience with Folbex VA. Page 76 from "XXXth International Apicultural Congress: program and abstracts report".

For treating honeybee colonies infested with V. jacobsoni or A. woodi.

a71 SHARMA, O.P.; GARG, R.; DOGRA, G.S. (1983) Efficacy of formic acid against Acarapis woodi (Rennie). Indian Bee Journal 45(1) : 1-2 [En, B, AA619/86]

Three honeybee (Apis mellifera) colonies infested with A. woodi at Nagrota-Bagwan, India, were treated with 85% formic acid which was allowed to evaporate from a cotton wick in a container on the bottom board. The container was filled with 5 ml formic acid every day for 21 days. Samples of 20 bees were inspected daily; 76.6% were infested on day 1, 16.3% on day 14, 0% from day 16 onwards. A. woodi eggs were not found in samples taken after day 8. No effects on honeybee brood mortality or adult lifespan were observed.

a72 SKRYPNIK, E.I. (1965) [Testing Tedion for treating acarine disease.] Pchelovodstvo 85(3) : 15-17 [Ru, B, AA304/66]

Various agents were tested. Tedion [tetradifon] proved to be non-toxic to bees and highly effective as a curative and prophylactic agent.

a73 WEISS, K. (1952) Wie wirkt die zur Milbenbekämpfung angewandte Senfol-Methanolbegasung auf die Bienen? [Effect on bees of mustard oil - methanol

2.68 continued

vapour used as an acaricide.] Zeitschrift für Bienenforschung 1(9) : 179-188 [De, B, AA35/55]

The vapour from a 2% solution of mustard oil (Oleum sinapsis) in methanol, or either substance separately, killed all bees placed in it in an air-tight flask (0.006% by volume). When the mixed vapour was allowed to evaporate in a single-frame nucleus hive, the bees were affected; if evaporation was then stopped immediately, they recovered.

The recommended dose per hive is 50 ml of a 2% solution of mustard oil in methanol, to be repeated after 5-6 weeks; this will not harm the bees.

2.7 RESIDUES OF CHEMICALS IN HONEY

No publications were found on the subject.

2.8 LEGISLATION

GERMAN FEDERAL REPUBLIC. LAWS, STATUTES ETC. (1975) Erlass des Ministeriums für Ernährung, Landwirtschaft und Umwelt zur Ausführung der Bienenseuchenverordnung. [Decree of the Department of Nutrition, Agriculture and Environment for the execution of the honeybee disease regulation.] Bienenpflege (12) : 237-240 [De, B]
Concerns acarine disease and foulbrood.

KOCH, H. (1956) Le problème de l'acariose en Belgique.
The full entry, with annotation, is in 2.21.

MICHAEL, A.S. (1961) The Honeybee Act and the acarine problem.
The full entry, with annotation, is in 2.52.

WELTER, W. (1976) Gesetzliche Vorschriften zur Verhütung und Bekämpfung der bösartigen Faulbrut und der Milbenseuche. [Legal regulations for preventing and controlling American foulbrood and acarine disease.] Die Biene 112(11) : 411-414 [De, B]

WILLE, H. (1983) Die Bekämpfung der Acarapismilbe: Wie wird die Anzeigepflicht eingehalten?
The full entry, with annotation, is in 2.52.

3 VARROA JACOBSONI

3.1 GENERAL

3.11 BOOKS

AIGUILLON (1983) Spécial varroase. [Special issue on varroa disease.] Aiguillon 24 pp. [Fr, B, AA249L/86]

ALPATOV, V.V. (AND 6 OTHERS, EDITORS) (1977) [*Varroa* infestation of honeybees.] Moscow, USSR : Izdatel'stvo Nauka 117 pp. [Ru, B, AA1043/79]

This book contains 29 chapters by various authors, as follows:

pp. 5-9 Poltev, V.I.: Epizootics of varroa disease.

pp. 9-12 Alpatov, V.V.: *Varroa jacobsoni* in other countries.

pp. 13-16 Lange, A.B.; Natskiĭ, K.B.; Tatsiĭ, V.M.: On some peculiarities of the biology of *Varroa jacobsoni*, a parasite of bees.

pp. 16-18 Sal'chenko, V.L.: The biology of the cause of varroa disease, the mite *Varroa jacobsoni* and an investigation into means of combating it.

pp. 19-23 Alpatov, V.V.; Lange, A.B.; Natskiĭ, K.B.; Tatsiĭ, V.M.: Work on the testing and application of treatments against *Varroa.*

pp. 23-31 Grobov, O.F.: Pharmacological preparations for combating *Varroa*.

pp. 31-33 Stolbov, H.M.: The elaboration of measures against varroa disease.

pp. 33-36 Alpatov, V.V.: Towards a method of developing therapeutic preparations and evaluating their effectiveness against *Varroa*.

pp. 36-37 Gaponova, V.S.; Mel'nik, V.N.: Some data on varroa disease and its treatment.

pp. 37-43 Pankova, S.V.: Haemolymph of the honeybee.

pp. 44-48 Simetskiĭ, M.A.; Smirnov, A.M.; Kudryavtsev, E.A.: The application of "Varroatin" as an aerosol treatment against *Varroa*.

pp. 48-54 Koptev, V.S.: The treatment of varroa disease with naphthalene.

pp. 54-58 Chebotarev, I.I.: The effectiveness of complex treatments for varroa disease.

pp. 58-60 Lange, A.B.; Natskiĭ, K.B.; Stolbov, N.M.; Tatsiĭ, V.M.: The arrangement of trials for treatments against *Varroa*.

pp. 61-66 Alpatov, V.V.; Lange, A.B.; Tatsiĭ, V.M.; Natskiĭ, K.B.; Chernov, K.S.: The selection and development of substances for use against *Varroa*.

pp. 66-71 Likhotin, A.K.: The application of acaricides against *Varroa*.

pp, 71-75 Stolbov, N.M.; Vas'kov, N.A.: Measures against *Varroa jacobsoni* in apiaries in the Tyumansk region.

pp. 75-76 Gavrilov, B.N.: Epizootiology of varroa disease in honeybees.

pp. 76-80 Chanyshev, Z.G.: *Varroa* in Bashkiria.

pp. 80-82 Vyazovskiĭ, E.N.: Late autumn and early spring treatment against *Varroa*.

pp. 82-85 Grobov, O.F.: A study of material from the alighting boards of hives infested with *Varroa*.

pp. 85-86 Mikityuk, V.V.; Sedin, I.F.; Fomenkov, A.P.: Studies of acaricides for varroa disease.

pp. 87-92 Ankinovich, G.A.; Khazbievich, L.M.: Management of honeybee colonies infested with *Varroa* in the Moscow area.

pp. 93-95 Khazbievich, L.M.: A "sanpropusknik" [cage for treating bees] in an apiary infested with *Varroa*.

pp. 95-98 Khazbievich, L.M.: An electrothermal device for introducing aerosol treatments into a hive.

3.11 continued

pp. 98-101 Petrov, S.G.: Protein food for colonies with varroa disease.
pp. 102-103 Ilbyushenkov, M.S.: The biology of *Varroa jacobsoni*.
pp. 104-106 Tatsiĭ, V.M.: The wintering of bees with varroa disease.
pp. 107-114 Khazbievich, L.M.: Short communications [on *Varroa*].

ANKINOVICH, G.B.; GROBOV, O.F.; PETROV, S.G.; POCHINIKIN, V.I.; KHAZBIEVICH, L.M. (EDITORS) (1981) [Varroa disease of honeybees.] Moscow, USSR : Moskovskoe Obshchestvo Ispytateleĭ Prirody 80 pp. [Ru, B, AA274/84]
This is a collection of short papers on various aspects of varroa disease, published by the Moscow Society of Naturalists. Topics discussed include: biological characteristics of *V. jacobsoni*; effects of *V. jacobsoni* on the honeybee colony; control methods, especially heat treatment and the use of sulphur, endosulfan and Neoron; experimental methods.

APIMONDIA (1977) Varroasis, a honeybee disease. Bucharest, Romania : Apimondia Publishing House 92 pp. [En, B, AA948/78]
This is a collection of excerpts from various journals and from an Apimondia Symposium in Sofia, Bulgaria, in 1976. The one long paper is by O.F. Grobov (pp. 46-70), and 71-84 carry photographs and drawings. There is a combined list of 163 references.

CAVALLORO, R. (EDITOR) (1983) *Varroa jacobsoni* Oud. affecting honey bees: present status and needs. Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities ix + 107 pp. + 9 pl. [En, B, AA1266/84]
This book contains the proceedings of a meeting of the European Communities Experts' Group in Wageningen, on 7-9 February 1983. The 4 main sessions covered: extent of *Varroa* infestations and effects; existing rules and regulations (Denmark, Netherlands, Ireland); biology; control. D.A. Griffiths et al. presented "The view of the acarologists"; a session on research included contributions by J. Louveaux (France) and J. Beetsma (Netherlands). Final discussions, conclusions and recommendations of the meeting are summarized on pp. 91-96. There is a bibliography of recent literature, and a list of participants.

ÖZBEK, H.; ECEVIT, O. (1984) Bal arisi (*Apis mellifera* L.) 'da varroa akari, *Varroa jacobsoni* (Oudemans) (Acarina: Varroidae). [The varroa mite affecting the honeybee.] Ankara, Turkey : Zirai Mücadele ve Zirai Karantina Genel Müdürlüğü iii + 35 pp. [Tr, B, AA/86]

RADEMACHER, E.; GEISELER, E. (1984) Die Varroatose der Bienen: Geschichte, Diagnose, Therapie. [Varroa disease of honeybees; history, diagnosis, therapy.] Berlin, German Federal Republic : Schelzky & Jeep 104 pp. [De, B, AA1343/85]
The history of the spread of *V. jacobsoni* to various countries is summarized, and a map shows the position in June 1984. Its spread in the German Federal Republic since 1975 is also described. There are short chapters on the biology of the mite, symptoms shown by infested honeybee colonies, and methods of diagnosis. Chemicals used against *Varroa* are listed (pp. 39-42); each chemical has a short note giving, e.g. countries where it has been used and its effectiveness. Methods of application are summarized on pp. 42-49. Physical and biological control methods are described and compared. German bee disease regulations which apply to *Varroa* are reproduced (pp. 82-95). The bibliography contains about 90 references, most of which are in German. There is no index.

3.11 continued

TUTKUN, E.; İNCİ, A. (1985) Bal arisinda zarar yapan ari akari (Varroa jacobsoni Oudemans) 'nin taninmasi, yayilişi, biyolojisi ve mücadelesi. [Varroa jacobsoni mites causing damage to honeybees: identification, distribution, biology and control.] Ankara, Turkey : Yenigün Matbaasi iv + 88 pp. + 6 pl. [Tr, en, B, AA633/86]

It is suspected that V. jacobsoni was introduced into the Thrace region of Turkey from Bulgaria in 1976; its presence was confirmed in the Aegean region in 1978 and it spread throughout Turkey in 1978-82. It is estimated that 25-30% of honeybee colonies were destroyed or seriously damaged. Tests of various chemical control agents in 1978-84 showed that the most effective method was to use 0.1% malathion dust at 1 g/hive, giving 3-4 applications at 5-day intervals in early spring and late autumn. Gas chromatography revealed 0.0009-0.021 ppm malathion in samples of honey taken from treated colonies; the Codex Alimentarius tolerance limit for malathion is 0.5 ppm. Malathion was therefore recommended for use in Turkey by the Ministry of Agriculture and Forestry in 1981.

3.12 BIBLIOGRAPHIES

BEETSMA, J. (1983) Recent bibliography on Varroa jacobsoni Oud. Pages 99-103 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1279L/84]

DE JONG, D.; MORSE, R.A. (1979) Annotated bibliography on Varroa jacobsoni, Tropilaelaps clareae and Euvarroa sinhai. Bibliography, International Bee Research Association No. 15 : 36 pp. [En, B, AA1352L/80]

Revision of 1976 ed., with 249 additional references.

3.13 MISCELLANEOUS PUBLICATIONS

ALLGEMEINE DEUTSCHE IMKERZEITUNG (1980) Die Varroatose der Honigbiene. Ausbreitung in Europa - Diagnose - Behandlung. Stand März 1980. [[Special number on] Varroa disease of honeybees. Its spread in Europe - diagnosis - treatment. The position in March 1980.] Allgemeine Deutsche Imkerzeitung 14(5) : 129-167 [De, B, AA1009/81]

This issue consists of 11 reports and discussions of all the studies on V. jacobsoni made at the Institut für Bienenkunde, Oberursel, in the last 3 years. An outlook for the future and a list of relevant publications are also given.

APIMONDIA (1979) Prophylaxis and control of varroa disease. - OIE/Apimondia Bee Pathology Seminar, Bucharest, Romania, 21-24 August 1978. Bucharest, Romania : Apimondia Publishing House 120 pp. [En, B]

BÖTTCHER, F.K. (1984) Der Varroatose. [Varroa disease.] Pages 212-229 from "Krankheiten der Biene" by E. Zander and F.K. Böttcher, Stuttgart, German Federal Republic : Eugen Ulmer 7th ed. [De, B]

BURGETT, D.M.; KRANTZ, G.W. (1984) The future of the European honey bee Apis mellifera L.) in southeast Asia: constraints of parasitism. Pages 34-43 from "Proceedings of the Expert Consultation on Beekeeping with Apis

3.13 continued

mellifera in Tropical and Sub-tropical Asia, Bangkok/Chiang Mai, Thailand, 9-14 April 1984" Rome : FAO [En, B]

Deals mainly with *V. jacobsoni* and *T. clareae*.

CHAMOUX, H.M.L. (1977) La varroase, une nouvelle et dangereuse parasitose des abeilles (*Varroa jacobsoni* Oudemans, 1904). [Varroasis, a new and dangerous parasitic disease of honeybees (*Varroa jacobsoni*).] Thèse pour le Doctorat Vétérinaire, École Nationale Vétérinaire d'Alfort, France : iii + 78 pp. [Fr, B, AA1302/78]

Information in 67 publications, covering the anatomy and biology of the parasite, and the symptoms, diagnosis, incidence, prophylaxis and treatment of the disease is reviewed. Commercially available chemicals used for treatment of the disease are described, with notes on methods of application, efficiency and disadvantages.

FRITZSCH, W.; BREMER, R. (1984) Varroatose (Varroose). [Varroa disease.] Pages 46-67 from "Bienengesundheitsdienst", Jena, German Democratic Republic : Gustav Fischer 2nd ed. [De]

KOROMYSLOV, G.F. (EDITOR) (1981) [Research on *Varroa jacobsoni* infestation of bees, conducted at the All-Union Institute for Experimental Veterinary Science, Moscow.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 59-78 [Ru, AA1281/83]

The topics described include: mixed infections (*V. jacobsoni* and *Aspergillus*); effects of some physical factors on bees and *V. jacobsoni*; effects of some chemosterilants on bees and *V. jacobsoni*; acaricidal activity of some synthetic scents and their toxicity to bees (particularly elenol and ionone); acaricidal effects and toxicity to bees of substances fed to bees for the control of *V. jacobsoni* (e.g. chlordimeform); effects of various acaricides on *V. jacobsoni* (particularly chloropropylate and chlorobenzilate); effect of chloropropylate on biochemical properties of honeybee blood; use of biological agents (derived from *Bacillus thuringiensis*) against *V. jacobsoni*.

PFEFFERLE, K. (1984) Die neue Aussenmilbe (*Varroa jacobsoni*). [The new external mite.] Pages 140-181 from "Imkern mit dem Magazin", Münstertal/Schwarzwald, German Federal Republic : K. Pfefferle 6th ed. [De, B, see AA918/85]

RITTER, W. (1981) Varroa disease of the honeybee *Apis mellifera*. Bee World 62(4) : 141-153; IBRA Reprint M106 [En, B, AA590/82]

In this review, with 46 references, the author describes the biology and epidemiology of *V. jacobsoni*, gives methods for diagnosing its presence, and lists various sprays, powders, fumigants and systemic agents that have been used for its control. Biological control methods, i.e. brood removal and heat treatment, are also described. Measures for minimizing the further spread of the mite are discussed.

RITTER, W. (1984) Neuester Stand der diagnostischen und therapeutischen Massnamen zur Bekämpfung der Varroatose. [Latest situation in relation to the diagnostic and therapeutic measures for the control of varroa disease.] Tierärtzliche Umschau 39(2) : 122-124, 127 [De, en, B, AA/86]

The commonest method of diagnosis is the examination of debris in late summer or winter from all colonies in an apiary. The examination of sealed brood and adult bees provides an effective diagnosis in the late stage of infestation. The treatment of colonies on combs has to be repeated every year.

3.13 continued

SLOVENSKI ČEBELAR (1980) [Special issue on Varroa.] Slovenski Čebelar 82(2) : 41-136 + 8 pl. [Sn, B, AA632/81]

This special issue contains the following articles on various aspects of varroa disease:

pp. 43-45 Klun, L.: Varrooza na Japonskem [Varroa disease in Japan].

pp. 46-64 Mencej, M.: Varrooza v Sovjetski zvezi [Varroa disease in the USSR].

pp. 65-87 Klun, L.: Varrooza v LR Bolgariji [Varroa disease in Bulgaria].

pp. 88-99 Senegačnik, E.: Varrooza v Zvezni Republiki Nemčiji in Nemški Demokratični Republiki [Varroa disease in the German Federal Republic and German Democratic Republic].

pp. 100-114 Mihelič, J.: Varrooza v SFR Jugoslaviji [Varroa disease in Yugoslavia].

pp. 115-128 Klun, L.: Unicevanje klopov Varroa s toploto [Heating apparatus for destroying Varroa].

pp. 129-132 Kopitar, M.: Republiški ukrepi za preprečevanje vdora, širjenja ter zatiranja varrooze v Sloveniji [Regulations for preventing the spread of varroa disease in Slovenia].

pp. 133-135 Klun, L.: Technologija čebelarjenja in zatiranje varroe [Beekeeping technology and varroa disease].

The 8 pages of colour photographs show V. jacobsoni parasitizing bee brood and adults, the appearance of parasitized colonies, and treatment of colonies with chemicals.

SMIRNOV, A.M. (1978) Research results obtained in USSR concerning aetiology, pathogenesis, epizootiology, diagnosis and control of Varroa disease in bees. Apiacta 13(4) : 149-162 [En, B, AA576L/80]

This is a review.

SMIRNOV, A.M.; VORONKOV, I.M. (1979) [Prevention and control of Varroa jacobsoni infestations of honeybees.] Veterinariya, Moscow, USSR No. 10 : 87-89 [Ru, B, AA1016/81]

This is a report of an international conference held in Bucharest, Romania. Papers were presented on: the life history of the Varroa mite; its method of feeding: means of control; the possibility of producing strains of bees resistant to infestation; new acaricides to kill mites that have developed resistance to the commoner ones used; physical means of control; biological control with micro-organisms (so far unsuccessful).

SMIRNOV, A.M.; POPOV, E.T. (1983) [Prophylaxis of Varroa jacobsoni infestations of honeybees: a review.] Vestnik Sel'skokhozyaistvennoi Nauki No. 4 : 112-115 [Ru, en, B, AA583/85]

A brief survey of some recent Russian work on V. jacobsoni, including its morphology and reproduction. It is also reported that the mite does not survive on wasps, bumble bees and flies, and that Varroa probably transports pathogens of certain honeybee diseases between colonies. Of the many products and methods tested for controlling Varroa, several chemicals have been found initially to be reasonably effective, but resistant strains of the mite have eventually developed. In USSR beekeepers are beginning to use hives designed to make treatments for Varroa more effective.

WEISS, K. (1984) Krankheiten der Bienenbrut. C.1. Brutmilbenkrankheit (Varroatose). [Honeybee brood diseases. C.1. Brood mites (varroa disease).] Pages 62-80 from "Bienen-Pathologie", Munich, German Federal Republic : Ehrenwirth Verlag [De, B]

3.2 SPREAD AND WORLD DISTRIBUTION

3.21 HISTORICAL AND GENERAL

AKRATANAKUL, P.; BURGETT, M. (1975) Varroa jacobsoni: A prospective pest of honeybees in many parts of the world. Bee World 56(3) : 119-120 [En, B, AA817/75]

The life history and distribution of the tropical mite V. jacobsoni are described, and reports of its occurrence on Apis mellifera and Apis cerana in 13 countries are listed in chronological order. The mite is reported from Thailand for the first time.

It is considered that the ability of V. jacobsoni to overwinter in hives in temperate regions is due to the relatively high temperature of the honeybee winter cluster. The mite could become a serious problem in Europe, Africa, Australia and the Western Hemisphere, and further work on its biology and control are needed.

ALPATOV, V.V. (1976) [A fatal error in determining a race of honeybee.] Priroda, USSR No. 5 : 72-73 [Ru, E1523, B, AA559/77]

There is no indigenous Apis mellifera in Primor'e region of USSR, only Apis cerana. The population of the "Far Eastern bee" there is descended from (largely Ukrainian) bees taken by settlers in or before the early part of the century. The bees have been mistakenly imported into other parts of USSR and elsewhere, as good honey producers; they have brought with them Varroa jacobsoni that is parasitic on Apis cerana in wild colonies (and now on Apis mellifera) in Primor'e.

ALPATOV, V.V. (1977) [Varroa jacobsoni in other countries.] Pages 9-12 from "Varroa infestation of honeybees" ed. V.V. Alpatov and 6 others, Moscow, USSR : Izdatel'stvo Nauka [Ru, E1552, B, AA1044/79]

The author briefly reviews present knowledge about the distribution of this mite, and suggests that parasitism by it arose 15-70 million years ago, on Apis cerana and A. dorsata. Over the years a balanced relationship evolved and the bees developed an immunity. Recent introductions of Apis mellifera (without immunity) into territory occupied by the Asian Apis species has led to serious outbreaks of disease and to the spread of the mite.

CRANE, E. (1978) The Varroa mite. Bee World 59(4) : 164-167; also Bee World (1979) 60(1) : 8 [En, B, AA1040/79]

This review summarizes known and postulated routes by which this mite, parasitic on honeybees, has been distributed. Varroa first spread through much of Asia, and was recently imported (on bees) to many European countries, via European USSR, and to South America from Japan. The present distribution is ascertained, and, to prevent further spread, beekeepers are advised not to import bees or queens from infested areas.

The damage to colonies caused by the mite, and methods of confirmation of infestation, are summarized.

GONÇALVES, L.S.; DE JONG, D.; MORSE, R.A. (1985) Varroa infestation in South America. Pages 71-72 from "XXXth International Apicultural Congress : program and abstracts report" [En, B]

V. jacobsoni is now confirmed in Argentina, Uruguay, Brazil, Bolivia, and Peru. It is quite possible that the mites are already in Colombia and Venezuela.

3.21 continued

Infested bee brood was brought into Brazil in 1972, and the mites are now present in 18 of 23 states. Migratory beekeeping has been responsible for the long distance spread. It is characteristic of varroa that, once in an area, all colonies become infested.

In some climates, the varroa population appears to stabilize. In colder areas of Argentina, colonies die as a result of infestations, but in warmer regions, infestations do not reach a high level. This is quite different from the situation in Europe.

GRIFFITHS, D.A.; BOWMAN, C.E. (1981) World distribution of the mite Varroa jacobsoni, a parasite of honeybees. Bee World 62(4) : 154-163 IBRA Reprint M107 [En, B, AA591/82]

The results are given of a world survey by acarologists. A table lists the 83 countries to which questionnaires were sent, with the replies received (negative, positive, no reply). The information acquired has been incorporated into a distribution map which shows countries in which the presence of V. jacobsoni is established or suspected, and in which it is absent (in February 1981). The results indicate that V. jacobsoni is absent from Australasia and the Pacific islands, present in at least 14 countries in Asia and the Middle East, absent from Africa apart from Tunisia and Algeria, present in only Brazil and Paraguay in Central and South America, absent from North America, and present in 10 European countries, including the USSR. In June 1981 Varroa was also discovered in Gonizia, Italy, near the border with Yugoslavia.

The survey shows that the usual ways for the mite to enter a country are: (1) importation of honeybee colonies; (2) crossing of a national frontier through local trading, movement of swarms, and drifting of individual bees. Only from Paraguay has there been direct evidence that queen importation was responsible for the initial outbreak.

MARIN, M. (1978) World spread of Varroa disease. Apiacta 13(4) : 163-166 [En, B]

NIXON, M. (1983) World maps of Varroa jacobsoni and Tropilaelaps clareae, with additional records for honeybee diseases and parasites previously mapped. Bee World 64(3) : 124-131 [En, B, AA592/84]

This report updates information about 8 major honeybee diseases and parasites published in 1982, and provides maps and records for V. jacobsoni and T. clareae. The information about V. jacobsoni includes records obtained in 1981, by Griffiths and Bowman. Other mites associated with honeybees are discussed.

RUTTNER, F. (1983) Varroatosis in honeybees: extent of infestation and effects. Pages 7-13 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1267/84]

The distribution of V. jacobsoni in Europe is described, the main emphasis being on ways in which the mite is spread - by honeybee imports from one country to another, by migratory beekeeping, and "on the wing". It is concluded that V. jacobsoni will continue to spread to the west and south of Europe.

SANDEL, M. (1986) Le découvreur du varroa: Jacobson (1870-1944). [The discoverer of varroa: Jacobson.] Fruits et Abeilles (March) : 101 [Fr, B]

Note: Sections 3.22-3.25 contain post-1982 reports of incidence in individual countries; for Europe, countries have individual headings.

3.22 INCIDENCE IN AFRICA

FAVEAUX, M.A. DE (1984) Les acariens et les insectes parasites et prédateurs des abeilles, Apis mellifica intermissa Buttel-Reepen, en Algérie. [Parasitic mites and insect parasites and predators of honeybees, Apis mellifica intermissa, in Algeria. Bulletin Zool. Agri., Institut National Agronomique, Algiers No. 8 : 13-21 [Fr, B, AA1334/85]

Varroa jacobsoni was first found in Algeria in 1981, but further investigations of the apiaries of beekeeping cooperatives was forbidden until the end of 1983. As the mite can spread rapidly, a programme of prevention and control isl needed urgently. Samples of honeybees from one region were examined for Acarapis woodi in 1980 and 1981, and none were found. However, the mite may be present in other areas.

KEETCH, D.P. (1984) The danger of varroa disease for S.A. [South African] beekeeping. South African Bee Journal 56(3) : 52-55 [En, B, AA1330L/85]

3.23 INCIDENCE IN THE AMERICAS

DE JONG, D.; STEINER, J.; GONÇALVES, L.S. (1984) Die Varroa in Brasilien. [Varroa in Brazil.] Allgemeine Deutsche Imkerzeitung 18(1) : 16, 21-22 [De, B, AA569L/85]

GONÇALVES, L.; DE JONG, D. (1985) Infestation of feral honey bee colonies in Brazil by Varroa jacobsoni. Pages 225-229 from "Proceedings of the XXIXth International Congress of Apiculture, Budapest, 1983", Bucharest, Romania : Apimondia Publishing House [En, B, AA261/86]

Of 32 feral colonies captured in various localities in São Paulo, Brazil, only 3 did not show evidence of being infested by V. jacobonsi, but the numbers of mites found were not as high as in managed colonies in the same areas. Clustered feral colonies were significantly more heavily infested than isolated colonies.

MONTIEL, J.O. (1984) Varroasis en la Argentina. [Varroa disease in Argentina.] Pages 203-209 from "Anais do 5° Congresso Brasileiro de Apicultura, Viçosa, MG, Brasil, 23 a 27 de julho de 1980" ed. L.S. Gonçalves et al., Viçosa, MG, Brazil : Universidade Federal de Viçosa [Es, en, pt, B, AA624L/86]

SHIMANUKI, H.; KNOX, D.A.; DELFINADO-BAKER, M.; LIMA, P.J. (1983) National honey bee mite survey. Apidologie 14(4) : 329-332 [En, B, AA959/85]

In 1980-82 samples of bees were submitted by 4400 apiaries throughout USA and Canada. Each sample was examined for the presence of V. jacobsoni and A. woodi. These mites were not found in any of the samples.

WILSON, W.T.; NUNAMAKER, R.A.; MAKI, D. (1984) The occurrence of brood diseases and the absence of the Varroa mite in honey bees from Mexico. American Bee Journal 124(1) : 51-53 [En, B, AA560/85]

Brood was examined in 89 colonies in modern hives in several areas (but not Yucatán); no V. jacobsoni mites were found.

3.24 INCIDENCE IN ASIA

OZER, N.; BOSGELMEZ, A. (1983) Ari akari. [The mite Varroa jacobsoni.] Mikrobiyoloji Bulteni 17(3) : 208-210 [Tr, en, B, AA257L/86]

YAKOBSON, B.A.; ROSEN, S.; HADANI, A.; STERN, Y. (1986) The occurrence and distribution of varroasis in apiaries in Israel. American Bee Journal 126(2) : 120-121 [En, B]

V. jacobsoni is reported for the first time in apiaries in Israel. Its distribution in the country has been studied. Field evidence suggests that the mite has invaded the apiaries in the Golan Heights through the Syrian border. A comprehensive control campaign has been launched and preliminary control measures use amitraz strips.

ZMARLICKI, C. (1984) Beekeeping with Apis mellifera and mite control in Burma. Pages 45-49 in "Proceedings of the Expert Consultation on Beekeeping with Apis mellifera in Tropical and Sub-Tropical Asia, Bangkok/-Chiang Mai, Thailand, 9-14 April 1984" Rome : FAO [En, B]

V. jacobsoni and T. clareae were present in every Apis mellifera colony examined. Mature colonies of Apis cerana examined were heavily infested with V. jacobsoni; the absconding rate is high. A combined treatment used on some A. mellifera colonies was effective: first, the queen was caged for 21 days so that there was a break in brood rearing, and then colonies were smoked with fumes of phenothiazine and potassium nitrate.

3.25 INCIDENCE IN EUROPE

Austria

KOHLICH, A.; PECHHACKER, H. (1983) Zur Varroatose: Derzeitige Situation in den Nachbarstaaten und notwendige Schlussfolgerungen für Österreich. [Varroa disease: current situation in neighbouring countries and necessary conclusions for Austria.] Bienenwelt 25(1) : 3-5 [De, B, E1602, AA1284L/-84]

Benelux

VAN PUL, P. (1984) Varroa mite detected in Benelux countries. American Bee Journal 124(2) : 110 [En, B]

Czechoslovakia

VČELAŘSTVÍ (1982) Tlumeni varroázy včel. [The struggle against varroa disease [in Czechoslovakia].] Včelařstvi 35 : 156-157; 179-181 [Cs, B, AA936L/84]; also published in Santé de l'Abeille No. 72; 73; 74 : 283-286; 12-15; 63-66 [Fr, B]

France

COLIN, M.E.; FAUCON, J.P.; HEINRICH, A.; FERRY, R.; GIAUFFRET, A. (1983) Étude du premier foyer français de varroatose de l'abeille. [Study of the first French locality of Varroa infestations.] Bulletin de l'Académie Vétérinaire de France 56 : 89-93 [Fr, en, B, AA234/85]

3.25 continued

V. jacobsoni was recorded from France for the first time on 1 November 1982 in Wissembourg (Bas-Rhin). Many apiaries were found to be infested with the mite, but at that time there had been no damaging effects; infestations were thought to be in their early stages. Migratory beekeeping is implicated in the spread of the mite.

German Federal Republic

GNÄDINGER, F. (1985) Aspects of the state-Varroa-disease-control in the Federal Republic of Germany. Pages 72-73 from "XXXth International Apicultural Congress: program and abstract report" [En, B]

In the control of varroa disease, the following must be considered:

(1) After diagnosis, the control according to the number of Varroa mites.

(2) In general, strict quarantine is not very convenient, and killing colonies for infection control is inefficient.

(3) Veterinary authorities must determine that: (a) treatments are carried out after the honey harvest, with tested methods, to avoid residues in the honey; (b) the colony is treated as few times as possible, but at the necessary doses (to avoid drug resistance appearing in the mites); (c) that the same remedies should be permitted in different states.

(4) Veterinary authorities should allow use of drugs by the beekeeper.

(5) Entire areas should be treated.

LIEBIG, G.; SCHLIPF, U.; FREMUTH, W.; LUDWIG, W. (1984) Ergebnisse der Untersuchungen über die Befallsentwicklung der Varroa-Milbe in Stuttgart-Hohenheim 1983. [Results of the investigation of the incidence of the varroa mite in Stuttgart-Hohenheim 1983.] Allgemeine Deutsche Imkerzeitung 18(6) : 185-191 [De, B]

MAUTZ, D. (1983) Zur Situation der Varroatose im Bundesgebiet. [The incidence of varroa disease in the German Federal Republic.] Imkerfreund 38(5) : 176-177 [De, B, AA276L/84]

ROJAHN, A. (1984) Bekämpfung der Varoatose in der Bundesrepublik Deutschland. [Control of varroa disease in the German Federal Republic.] Allgemeine Deutsche Imkerzeitung 18(12) : 382-386 [De, B]

Greece

EMMANOUEL, N.G.; SANTAS, L.A.; TAMBOURATZIS, D.G. (1984) Varroa disease and its control in Greece. Pages 1099-1106 from "Acarology VI, vol. 2" ed. D.A. Griffiths and C.E. Bowman, Chichester, UK : Ellis Horwood [En, B]

SANTAS, L.A. (1983) Varroa disease in Greece and its control with malathion. Pages 73-76 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1277L/84]

3.25 continued

Italy

FRILLI, F. (1983) Varroa jacobsoni: the situation in Italy. Pages 15-18 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1268L/84]

MARCHETTI, S.; BARBATTINI, R. (1985) Diffusione della varroasi nella regione Friuli-Venezia Giulia. [Spread of varroa disease in the region of Friuli-Venezia Giulia.] Informatore Agrario 41(25) : 77-81 [It, B, AA/86]

PROTA, R. (1983) Sulla presenza di Varroa jacobsoni Oud. in Sardegna. [The presence of Varroa jacobsoni in Sardinia.] Studi Sassaresi 30 : 255-264 [It, en, B, AA636L/86]

The presence of V. jacobsoni is reported for the first time in Sardinia.

SOMMARUGA, A.; TONESI, R. (1985) Study on the course of Varroa jacobsoni infestation and possibility of control in northern Italy. Page 72 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

In Italy the first report of V. jacobsoni was in 1981; from then the parasite has spread widely and up to now its presence has been reported in many places. The course of varroa infestation was studied in normal conditions of climate and breeding in an apiary in northern Italy. Mite mortality was recorded in 40 colonies, both natural mortality and as a result of treatment.

Poland

CHMIELEWSKI, W. (1982) Warrooza pszczół (Apis mellifica L.) powodowana przez Varroa jacobsoni Oudemans (Varroinae, Acarina) w Polsce. (Varroa disease of honeybees caused by Varroa jacobsoni in Poland.] Wiadomości Parazytologiczne 28(1/2) : 109-110 [Pl, en, B, AA236/85]

Varroa jacobsoni was found for the first time in Poland, in Zamość, in spring 1980. Fumigation with Folbex (chlorobenzilate) and examination of brood combs revealed very high infestations of adult workers and larvae in some colonies.

SZYJA, J.; PIOSCZEK, A. (1984) Warroza - nowy problem w patologii pszczol. [Varroa disease - a new problem in honeybee pathology.] Zycie Weterynaryjne 59(2) : 69-71 [Pl, AA255L/86]

Scandinavia

HANSEN, H. (1983) The extent of the Varroa infestation in Scandinavia. Pages 19-20 from Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1269L/84]

3.25 continued

Yugoslavia

SINKOVIĆ, M.; SARIĆ, B. (1984) Zdravstveno stanje pčela na terenu Severne Bačke. [Bee health in North Bačka.] Veterinarski Glasnik 38(11) : 891-894 [Sh, en, ru, B, AA620/86]

In spring 1983, 2439 colonies belonging to migratory beekeepers in the Bačka region were examined for nosema disease, and for *V. jacobsoni* infestations. Nosema disease was found in 630 (26%) colonies, and *Varroa* in 826 (34%). *Varroa* is widespread in northern Bačka, but a few areas are still free from it. The spread of honeybee diseases and pests is being made worse by the increase in migratory beekeeping and the shortage of effective medicines.

VUKCEVIC, V. (1983) Pojava i sirenje varooze u crnoj gori. [Occurrence and spread of *Varroa jacobsoni* infestations in Montenegro [Yugoslavia].] Poljoprivreda i Sumarstvo 29(1) : 71-75 [Sh, en, AA631L/86]

UK

UNITED KINGDOM, MINISTRY OF AGRICULTURE, FISHERIES AND FOOD (1985) Varroasis of bees. Tobacco smoke detection. Pamphlet, Ministry of Agriculture, Fisheries and Food No. 936 : 2 pp. [En, B]

3.3 BIOLOGY OF VARROA JACOBSONI

3.31 GENERAL

BREM, S.; KOPP, H.; MEYER, P. (1983) Der natürliche Wintertotenfall von Varroa jacobsoni im Vergleich zur gesamten Milbenpopulation im Bienenvolk Untersuchungen an sechs Bienenvölkern. [The natural winter losses of Varroa jacobsoni in comparison with the whole mite population of the honeybee colony: an investigation of six colonies.] Tierärztliche Umschau 38(1) : 16, 18, 21 [De, en, B, AA1289/83]

Winter debris and samples of bees from each colony were examined by the flotation method. Colonies 1-4 had totals of 4, 7, 20 and 23 mites; the numbers in the debris of each colony were 1, 1, 6 and 1. In colony 5, a total of 959 mites was found, with only 5 in the debris, but in this colony the bees had access to the debris and so could remove it from the hive. In colony 6 only 1 mite was found in the debris, probably indicating a new infestation. It is concluded that low levels of infestation can be detected by examination of winter debris.

DE JONG, D. (1981) Effect of queen cell construction on the rate of invasion of honeybee brood cells by Varroa jacobsoni. Journal of Apicultural Research 20(4) : 254-257 [En, B, AA592/82]

In 6 honeybee colonies, the number of V. jacobsoni mites leaving adult bees and entering brood cells increased after queen cell construction. The number of mites per cell was greater on comb sides with queen cells than in other parts of the brood nest.

GROBOV, O.F.; SHABANOV, M. (1979) [Effect of climatic factors on mite Varroa jacobsoni Oudemans, 1904.] Doklady Bolgarskoi Akademii Nauk. 32(12) : 1701-1703 [Ru, B]

IFANTIDIS, M.; LAERE, O. VAN; WAEL, L. DE (1985) A test cage for studying the biology of the bee parasite Varroa jacobsoni and the efficiency of acaricides. Pages 234-236 from "Proceedings of the XXIXth International Congress of Apiculture, Budapest, 1983", Bucharest, Romania : Apimondia Publishing House [En, B, AA262/86]

The cage described is composed of a cover, a central part, and a bottom. The central part is made from upper and lower perspex rings between which is a cylinder made of stainless steel gauze, 0.35 mm thick, with 0.76-mm meshes which prevent mites from escaping. The cover has 2 openings; the first contains a holder for solid food, the second has 2 holes through which liquids can be sucked. Bees can be introduced through either of the cover's openings. The cage can be exposed to fumigants, or food containing acaricides can be placed in the cover. Dead mites drop through a stainless steel gauze having 1.71-mm meshes into the perspex bottom of the cage.

IONESCU-VARO, M.; SUCIU, M. (1979) Preliminary results of anatomical and histological examination of the Varroa jacobsoni Oud. mite. Apiacta 14(2) : 53-60 [En, B]

LANGE, A.B.; NATSKIĬ, K.V.; TATSIĬ, V.M. (1976) [Biology of Varroa.] Veterinariya, Moscow, USSR No. 7 : 74-77 [Ru, B, AA236L/79]

LO KANG-CHEN; CHAO ROU-SU (1975) [Preliminary investigations on bee mites in Taiwan.] Journal of Agricultural Research of China 24(1/2) : 50-56 [Ch, en, B, AA1299/77]

3.31 continued

Neocypholaelaps indica was the most common mite associated with both *Apis cerana* and *Apis mellifera*; it is a phoretic mite. *V. jacobsoni* was the most important parasitic mite on *Apis mellifera*. It was seen on bees' bodies between thorax and abdomen on the upper side, and between the first 3 abdominal segments at the side. There were up to 12 female mites on worker pupae (mean 3.56), 14 on drone pupae (mean 5.77). The male was not found. Development of juveniles into adult mites took 8-9 days at 30°C. The morphology of the various stages is described and illustrated.

NEPOMNYASHCHIKH, V.A. (1980) [Behaviour of *Varroa jacobsoni* under stress.] Zhurnal Obshcheĭ Biologii 41(6) : 873-878 [Ru, en, B, AA28/83]

A laboratory study of female *V. jacobsoni* isolated from their honeybee hosts and exposed to temperatures higher or lower than under natural conditions revealed conflicting behaviour patterns which were intensified under abnormal temperatures and during oviposition. As a result, new stereotyped behaviour patterns were formed.

POLTEV, V.I. (1978) [Characteristics of the course of varroa disease of honeybees.] Sbornik Nauchnykh Trudov, Moskovskaya Veterinarnaya Akademiya 99 : 123-124 [Ru, B, AA630/81]

In the USSR *Varroa* infestations are most severe in southern regions where the winter is short and the mite multiplies almost without interruption. In the north, where the bees produce no brood during the winter, the mite ceases to multiply and most die, but some females survive a winter of 5-8 months. In the central regions *Varroa* begins to multiply as soon as brood appears in the hive, and the population builds up rapidly to a maximum in the autumn. As the quantity of brood in the hive declines, the mites feed more on the haemolymph of adults. During the first and sometimes the second year that *Varroa* exists in an apiary it does comparatively little damage. Mortalities among the bees are not conspicuous, a reasonable honey crop is gained, and the colonies may winter well. In the third and fourth years, when mite populations have built up, losses become serious. Colonies build up poorly in the spring, little honey is produced, and many colonies die in the autumn.

ROBAUX, P. (1984) Biologie et comportement de *Varroa jacobsoni*. [Biology and behaviour of *Varroa jacobsoni*.] Bulletin Technique Apicole 11(2) : 101-115 [Fr, B, AA966L/85]

ROMANIUK, K.; DUK, S. (1983) Sezonowa dynamika rozwoju *Varroa jacobsoni* w nie leczonych rodzinach pszczelich. [Seasonal dynamics of *Varroa jacobsoni* development in untreated honeybee colonies.] Medycyna Weterynaryjna 39(12) : 725-727 [Pl, en, ru, B, AA245/85]

Observations were carried out in a 60-hive apiary at 1-month intervals from April to September 1982. Live workers and sealed brood were taken for examination from the same 16 colonies. These examinations preceded the analysis of debris from wintering colonies. It was found that the quantity of debris was inversely related to the strength of the wintering colony and directly related to the number of female mites found on the bottom board. Examination of live workers showed that the number of live *V. jacobsoni* females per 100 bees was low in the period from April to July (3.2-7.7); in August this number increased to 15.9, in September to 23. The number of female mites per 100 worker larvae was 7.5 in May, 8.1 in June, 14.9 in July, 29.7 in August and 134.7 in September. The highest number of parasites occurred on drone brood - 17.5 female mites per 100 larvae in May, 104.1 in June, 131 in July and 143 in August.

3.31 continued

RUIJTER, A. DE; PAPPAS, N. (1983) Karyotype and sex determination of Varroa jacobsoni Oud. Pages 41-44 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands: A.A. Balkema for the Commission of the European Communities [En, B, AA1272/84]

Marked worker cells, capped 2-4 h before, were opened with a needle and one old (A) or young (B) female Varroa mite was introduced into each. After 10 days the cells were re-opened and the eggs, larvae, nymphs and adult mites counted. The experiment was repeated using old (C) or young (D) mites which had been kept on caged honeybees for a week. Cells with A contained eggs/larvae and male and female nymphs; with B, eggs/larvae and young nymphs (sex not determined); with C, eggs/larvae and male and female nymphs, and one cell with one (male) adult; with D, eggs/larvae, male nymphs and male adults. It is thus concluded that V. jacobsoni is arrhenotokous i.e. unfertilized eggs produce only males. Chromosome studies of eggs stained with aceto-orcein confirmed that V. jacobsoni is haplo-diploid; n = 7 in males, 2n = 14 in females.

SADOV, A.V. (1976) [A study of the female Varroa mite.] Pchelovodstvo No. 8 : 15-16 [Ru, B, AA1299/78]

With Yu. Ya. Mikhaĭlov, the author showed (by feeding strontium-90 in food given to bees) that female varroa mites feed exclusively on bee haemolymph, particularly from the intersegmental regions of the abdomen. They can survive 2-3 days away from the host. Haemolymph represented 50.7% of the varroa body weight in autumn, 43.7% in summer and 44.6% in spring. The body weight of parasitized larvae is reduced, and the proportion that is protein is reduced by 15-20%. The life span of parasitized bees is reduced by up to 50%.

STEINER, J.; POMPOLO, S. DAS G.; TAKAHASHI, C.S.; GONÇALVES, L.S. (1982) Cytogenetics of the acarid Varroa jacobsoni. Revista Brasileira de Genética 5(4) : 841-844 [En, B, AA278/84]

The chromosome number of V. jacobsoni was determined by examining embryos dissected from adult females taken from recently sealed Apis mellifera brood cells; only 2 chromosome complements (7 and 14, representing haploid male and diploid female embryos respectively) were found. A figure shows 3 submetacentric and 4 acrocentric chromosomes in metaphase. The sex determination mechanism of V. jacobsoni is thus of the haplodiploid or arrkenotokous type.

ZOTOV, V.A.; NEPOMNYASHCHIKH, V.A. (1981) [Disturbances in biological rhythms as a result of conflict between incompatible motivations.] Zhurnal Obshcheĭ Biologii 42(4) : 622-627 [Ru, en, B, AA1049/82]

It has been assumed that an organism possesses various mechanisms each controlling different movements or other aspects of behaviour. If stimuli are received which cause separate acts of behaviour with different rhythms, this can result in conflict and a disturbance of total activity. For example, the rhythm of cleaning the forelegs in female V. jacobsoni is affected under conditions of stress so that the rhythm of alternate cleaning of left and right legs is disturbed.

3.32 ANATOMY AND MORPHOLOGY

AKIMOV, I.A.; YASTREBTSOV, A.V. (1984) [Respiratory system of the mite Varroa jacobsoni (Parasitiformes, Varroidea).] Vestnik Zoologii No. 3 : 45-49 [Ru, en, B]

The respiratory system in V. jacobsoni consists of 4 pairs of anterior and 4 pairs of superior tracheal stems, a pair of orifices, situated laterally between III and IV pairs of coxae, and a pair of peritremes, situated transversally. Preatrial and atrial chambers, giving the rise to tracheal stems and peritremal tubes, are connected with the orifices. A complex peritremal system is probably responsible for water balance during respiration. The active breathing movements (2-5 times/min) are due to opistosomal dorso-ventral muscles and external muscles of the walking legs. During locomotion tracheal ventilation is continuous.

AKIMOV, I.A.; YASTREBTSOV, A.V. (1984) [Reproductive system of Varroa jacobsoni 1. Female reproductive system and oogenesis.] Vestnik Zoologii No. 6 : 61-68 [Ru, en, B]

The anatomy of the reproductive organs are described. Oocytes are formed only in females that have not started egg-laying; the number of oocytes reaches 25/female. Some of the changes that occur with aging are described.

AKIMOV, I.A.; YASTREBTSOV, A.V. (1985) [Variability in certain characteristics of the mite Varroa jacobsoni - parasite of the honeybee.] Doklady Akademii Nauk Ukrainskoĭ SSR No. 8 : 58-60 [Ru, en, B]

A number of morphological characteristics which may serve as indicators of phenotypic variability in the mite were determined. There are several diagrams.

BUZA, L. (1979) Az azsiai nagy méhatka (Varroa jacobsoni Oudemans) morfológiája és biológiaja. [Morphology and biology of Varroa jacobsoni.] Magyar Allatorvosok Lapja 34(6) : 363-365 [Hu, en, de, ru, B, AA967L/80]

DELFINADO-BAKER, M. (1984) The nymphal stages and male of Varroa jacobsoni Oudemans a parasite of honey bees. International Journal of Acarology 10(2) : 75-80 [En, B, AA582/85]

The nymphal stages (protonymph and deutonymph) of V. jacobsoni are described for the first time and the adult male is redescribed. Morphological characters for accurate recognition of these developmental stages are figured and discussed as well as significant features found in the nymphal stages that provide further support for assigning V. jacobsoni separate family status.

EMMANOUEL, N.G.; PELEKASSIS, C.D.; SANTAS, L.A. (1983) Harmful mesostigmatic mites ectoparasitic to honey bees. Entomologia Hellenica 1 : 17-23 [En, B]

V. jacobsoni and Neocypholaelaps favus are widespread in Greece, while the existence of a third species Mellitiphis alvearius is quite probable. Among detailed drawings of all stages of V. jacobsoni those of immature stages are published for the first time.

GROBOV, O.F.; PULENETZ, N.M.; SOFRONOV, G.L. (1980) Geographical variability of the size of the dorsal scutellum in females of Varroa jacobsoni Oudemans. Pages 346-350 from "Proceedings of the XXVIIth International Congress of Apiculture, Athens, 1979", Bucharest, Romania : Apimondia Publishing House [En, B, AA1413/81]

3.32 continued

Results for 1571 females from 17 regions of the USSR showed wide variability; the average length of the dorsal scutellum ranged from 997 to 1147 µm and the average width from 1542 to 1688 µm. The average shape index (SI, which is the ratio of length to width) ranged from 0.54 to 0.68. A statistical analysis of the SI values and results from other countries indicated 4 groupings of mites; mites from places as far apart as Moscow, Japan, Leningrad and the German Federal Republic were all rather round in shape, with an SI of 0.64. Mites from the Amur area have an elongated body (SI 0.68), significantly different from all others.

HIRSCHMANN, W. (1980) Erstbeschreibung der Protonymphe, Deutonymphe und des Männchens sowie Wiederbeschreibung des Weibchens von Varroa jacobsoni Oudemans 1904. [First descriptions of the protonymph, deutonymph and males, and redescription of females, of Varroa jacobsoni.] Acarologie 27 : 60-66 [De, B, AA938L/82]

The descriptions are illustrated by drawings and scanning electromicrographs.

KAAS, J.P. (1983) Varroa onder het mes: een histologisch - anatomische verkenning van het inwendige van Varroa jacobsoni Oudemans 1904. (Varroa under the knife: a histological - anatomical investigation of the internal structure of Varroa jacobsoni.] Doctoraalverslag, Rijksuniversiteit te Leiden, Netherlands : 41 pp. [Nl, B, AA233/85]

The following are described, with photographs: digestive system, excretory organs, musculature, nerve tissue, glands and genitalia.

LIU, T.P. (1982) A scanning electron microscope study on the female mite Varroa jacobsoni (Oudemans, 1904). American Bee Journal 122(6) : 413-415 [En, B, AA614/83]

The idiosoma of the female V. jacobsoni is highly sclerotized; the body is oval and dorsoventrally flattened. The legs are short and stout, with the pretarsus developed into a strong sucker. Long, stiff setae cover the legs, especially the tarsal segments. The dorsal shield is covered with numerous branched setae, and has a row of thick, short and curved setae at its lateral edges. The significance of these morphological features in relation to the phoretic behaviour of the female mite is discussed.

POLYAKOV, A.A.; SMIRNOV, A.M.; KULIKOVSKII, A.V.; SMIRNOVA, O.I. (1975) [Varroa jacobsoni.] Pchelovodstvo 7 : 26-28 [Ru, B, E1459, AA386L/77]

Scanning electron microscope studies, with photographs.

RUIJTER, A. DE; KAAS, J.P. (1983) The anatomy of the Varroa-mite. Pages 45-47 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs", ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1273/84]

Male and female mites were studied by dissection and by examination of Giemsa-stained sections. Details of the internal anatomy and histology are illustrated by means of photographs and drawings. A detailed description of the female reproductive system is given. Some photographs show stages of spermatogenesis in males and maturation of spermatozoa within females.

SADOV, A.V. (1978) [Anatomy of females of the Varroa (jacobsoni) mite.] Pchelovodstvo No. 7 : 24-25 [Ru, B]

3.32 continued

SADOV, A.V. (1979) [The pretarsus - a vulnerable part of the Varroa mite.] Pchelovodstvo No. 11 : 18-20 [Ru, B, AA638L/81]

SADOV, A.V.; POLTEV, V.I.; CHUMAKOV, V.P.; GROBOV, O.F. (1980) [The pretarsus of the female Varroa and mechanism of its action.] Veterinariya, Moscow, USSR No. 2 : 36-39 [Ru, B, AA637/81]

The pretarsus, which is described, is not adapted for movement over a wet or dusty surface, and the mite is unable to move over a horizontal surface if this is covered with particles smaller than the diameter of the funnel-shaped extension of the pretarsus; on a sloping surface the mite falls off.

SADOV, A.V. (1980) [The respiratory apparatus of the female Varroa jacobsoni mite.] Veterinariya, Moscow, USSR No. 11 : 43-47 [Ru, AA1337/82]

The newly-hatched larva of V. jacobsoni has no tracheae, and respiration is cuticular. In the protonymph of the female, the respiratory system is already formed: a stigma is present, with a relatively short tongue-like peritreme extending from it. In the deutonymph, the peritremal tube lengthens to 280 µm, and in the adult, to 319 µm. The structure of the respiratory apparatus is described and illustrated. The apparatus enables the mite to withstand a wide range of unfavourable environmental conditions, and this must be taken into account when treating hives with a phenothiazine aerosol. The bottom of the hive should be covered with a layer of waxed paper smeared with vaseline, or sprinkled with dry talc powder, to trap mites. In the absence of a trap of this type, 20-50% of mites which drop to the bottom of the hive recover and re-attach themselves to their hosts.

SADOV, A.V. (1980) [Morphology of the mouthparts of the adult Varroa jacobsoni mite.] Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya 116 : 76-84 [Ru, B, AA1272/83]

The structure of the oral apparatus, including the claws and setae of the individual segments of the chelicerae and other appendages, are described in great detail. Internal parts, such as the salivary ducts and the sphincter and dilatory muscles of the gullet, are also described. The possible functions of the various structures in the mite's method of feeding are discussed. Attention is also drawn to the possibility that V. jacobsoni may act as a vector of bacterial and viral diseases of the honeybee.

3.33 LIFE CYCLE AND SURVIVAL

AKIMOV, I.A.; PILETSKAYA, I.V. (1985) [Egg viability in oviposition by the mite Varroa jacobsoni.] Doklady Akademii Nauk Ukrainskoĭ SSR, B, No. 1 : 54-56 [Ru, en, B, AA/86]

It was established that female V. jacobsoni lay eggs of different quality. It is suggested that eggs can be divided into three groups according to their size and degree of development: small, average and large. Only the largest eggs with larvae formed under the egg shells are viable. All other eggs, even with partially formed larvae, die after laying. An early (larval stage) morphological differentiation between females and males was detected. It is suggested that this, and the high death rate of eggs, are associated in V. jacobsoni with pathenogenesis by arrhenotoky.

3.33 continued

AVDEEVA, O.I. (1978) [Life cycle of the *Varroa* mite in laboratory conditions.] Pchelovodstvo No. 10 : 16-17 [Ru, B, AA981L/80]

CHOI, S.Y.; WOO, K.S. (1973) [Studies on the bionomics of bee mite, *V. jacobsoni* Oudemans, and its chemical control (I).] Research Reports of the Office of Rural Development, Suwon, Korea 15 (Livestock) : 35-43 [Ko, en, B, AA666/74]

V. jacobsoni has been found in honeybee colonies in Korea since 1968. A study of its biology showed that development from egg to adult took 10 days for females and 6 days for males. The adult females entered the honeybee brood cells just before capping and each laid about 5 eggs, which hatched with the young bees: 1-3 mites were found on adult workers and 1-8 on drones. "Hyang-Su", a mixture extracted from several plants (using 2 ml/comb) gave more effective control than Folbex or Neobex.

CHOI, S.Y. (1985) Current status on the bionomics and control of bee mites, *Varroa jacobsoni* Oudemans, in Korea. Page 73 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

The first report of the mites in Korea was in 1968. The bionomics of the mite have been studied in honeybee colonies, especially the development periods (from egg to adult took 10 days in the female and 6 days in the male and reproduction rate about 5 eggs laid by one female). Mites preferred to parasitize drones and their pupae, but the ratio of bee stages parasitized fluctuated greatly with season. A regression equation was calculated from the infestation of varroa mites and body weight loss of honeybees.

GROMYKO, G.I. (1982) [Survival of *Varroa* mites outside the hive.] Pchelovodstvo No. 5 : 16-17 [Ru, B, AA277/84]

Live *V. jacobsoni* may be removed from the hive in debris, or they may fall from foraging bees onto flowers. An investigation showed that mites can survive on flowers of white clover (*Trifolium repens*) and dandelion (*Taraxacum officinale*) for up to 5 days at 20-28°C and RH 70-75%. The female mite can survive for 5-6 days without food.

HARAGSIM, O.; SAMŠIŇÁK, K. (1986) Vývojová stadia roztoče *Varroa jacobsoni* Oudemans, 1904 (Acari: Dermanyssidae) [Development stages of the mite *Varroa jacobsoni*. Veterinární Medicína 31(2) : 105-112 [Cs, B]

A detailed taxonomic description of the developmental stages of female and male mites is presented. The female develops from egg into larva, nymph I and nymph II. No deutonymph II has been found in the development of the males, so it is assumed that, as in some other parasitic mite species, this stage is missing in *V. jacobsoni* males. From the morphology of the mouthparts it is concluded that the adult male cannot parasitize pupae or adult bees and that it does not take in food during its short life.

MORITZ, R.F.A.; HÄNEL, H. (1984) Restricted development of the parasitic mite *Varroa jacobsoni* Oud. in the Cape honeybee *Apis mellifera capensis* Esch. Zeitschrift für Angewandte Entomologie 97(1) : 91-94 [En, de, B, AA243/85]

Laying queens of *A. m. carnica* and *A. m. capensis* were kept in small nuclei in a flight room. The brood combs were examined every 6 h and the sealed cells marked on a transparent foil; after c. 100 cells had

3.33 continued

been marked the comb was kept in an incubator at 35°C. When the bees emerged each cell was marked again on the foil and the length of the post-capping stage determined. In a second experiment, a *V. jacobsoni* female was added to each of 25 cells through an opening in the capping, which was then re-closed. The mean length of the post-capping stage was 9.6 days in *A. m. capensis*, 12.0 days in *A. m. carnica*. The introduction of mites into the cells did not affect the duration of the post-capping stage. When the bees emerged none of the 25 *A. m. capensis* cells with an adult mite contained offspring capable of parasitizing a bee, whereas 7 of the 25 mite-containing *A. m. carnica* cells did so.

MURAVSKAYA, A.I. (1980) [The effect of lowered temperature on the mite *Varroa jacobsoni*.] Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya 116 : 87-90 [Ru, B, AA1271/83]

The optimal temperature for the development of *V. jacobsoni* is 34°C. Lowering the temperature to 30° for the first few days after placing nymphs in a controlled environment at an RH of 70-80% prevented further development, and the nymphs died.

OKUMURA, T.; WATANABE, K.; MIYAMA, K. (1985) Studies on the ecology of the honeybee mite *Varroa jacobsoni*. Pages 70-71 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Only adult female *Varroa* were found on drone brood for about 2 days after cell capping. Eggs and protonymphs of *Varroa* were found on the second and third days from the beginning of capping, respectively. No adult males were found until the fifth day. Adult female *Varroa* were always present during the cell capping period. The total population number of each developmental stage of the mite per drone cell increased rapidly from the second day to the sixth day after capping, when it reached a peak and then decreased gradually until the fourteenth day. The distribution pattern of mites attacking drone brood was found to be a contagious distribution.

PETROVA, A.D.; BYZOVA, YU.B.; TATSIĬ, V.M.; EMEL'YANOVA, O.YU. (1982) [Metabolic expenditures of *Varroa jacobsoni* Oudemans, 1904 (Mesostigmata, Varroidae) - an ectoparasite of the honeybee.] Doklady Akademii Nauk SSR 262(2) : 499-502 [Ru]; also in Doklady Biological Sciences 262(1-6) : 115-118 [En, B, AA950/84]

V. jacobsoni adults and nymphs were removed from honeybee brood or adult bees and their oxygen uptake was measured by open manometry. The effects of temperature, seasonal changes, and food deprivation were determined. The total metabolic expenditure of *V. jacobsoni* during its development into an adult was estimated to be 57.6 mm^3 oxygen, or 0.28 cal. On average, the daily oxygen consumption by an adult female mite at 33°C was 18.6 mm^3, at 22° and 4° it was 5.1 and 2.5 mm^3, respectively. If the lifespan of a wintering female is taken to be 150 days (at 4-22°), then total winter oxygen consumption will be 811 mm^3, or 3.9 cal. The energy value of 1 μl of blood from a wintering bee is 0.7 cal, therefore each mite needs to ingest 5.5 μl of honeybee blood during this period.

RADEMACHER, E. (1985) Untersuchungen zu einem Prognose-Modellversuch anhand des natürlichen Totenfalles von *Varroa jacobsoni*. [A predictive trial model based on investigations of the natural mortality rate of *V. jacobsoni*.] Apidologie 16(3) : 215 [De, B]

3.33 continued

RADEMACHER, E. (1985) Ist eine Befallsprognose aus dem natürlichen Totenfall von Varroa jacobsoni möglich? [Is a prediction of infestation by Varroa jacobsoni possible based on its natural death rate?] Apidologie 16(4) : 395-406 [De, B]

In the course of a year both the number of mites and their natural mortality rate vary. A prediction of the maximum infestation rate based on data from observations would be very helpful. Using the mortality rate during the month of July a prognosis for August/September (i.e. period of colony collapse due to Varroa infestation) is possible only on a regional basis. A relationship between mortality rate of mites and the infestation rate of a colony cannot be found, either from the results of Folbex treatment or from any models of population development and dynamics.

SADOV, A.V. (1980) [Survival ability of Varroa under various conditions.] Pchelovodstvo No. 1 : 17-18 [Ru, B, AA1412/81]

A study of the effect of various external factors on the female Varroa mite showed that the respiratory system was vulnerable to various factors. The survival of the mite in various liquids was studied, and the effect of exposure of mites to temperatures of 22, 34, or 40°C is reported. At 40° all mites were killed in less than 1 day.

SADOV, A.V. (1981) [Bee treatment and conditions of life activities of Varroa jacobsoni.] Veterinariia No. 4 : 47-49 [Ru]

SAKAI, T.; TAKEUCHI, K.; HARA, A. (1979) [Studies on the life history of a honeybee mite, Varroa jacobsoni Oudemans, in laboratory rearing.] Bulletin of the Faculty of Agriculture, Tamagawa University No. 19 : 95-103 [Ja, en, B, AA1015/81]

To obtain the maximum number of eggs for laboratory rearing, female mites were collected from honeybee larvae after cocoon spinning, and reared on pre-cocoon larvae at 35°C and RH 85%. Oviposition occurred once daily. In the laboratory, the development proceeded as follows: egg 1-2 days, protonymph 2-3 days, deutonymph 2 days, deutochrysalis 2 days. The protochrysalis stage could not be determined; the total period was 8-11 days. The egg was found to contain a larva with 3 pairs of legs suggesting that the mite enters the larval stage within the egg shell, and that the protonymph hatches directly from the egg.

SMIRNOV, V.M. (1978) [The length of life of winter generations of the Varroa mite.] Pchelovodstvo No. 12 : 14-15 [Ru, B, AA977L/80]

3.34 FEEDING, NUTRITION AND DIGESTION

AVDEEVA, O.I. (1979) [The biology of nutrition of the Varroa mite under laboratory conditions.] Pchelovodstvo No. 8 : 18-19 [Ru, B, AA979L/80]

Female mites must feed on the haemolymph of worker or drone brood in open cells before they are able to lay eggs.

BARABANOVA, V.V. (1983) [Digestive enzymes of Varroa jacobsoni.] Vestnik Zoologii No. 3 : 81-83 [Ru, B, AA244/85]

3.34 continued

Adult V. jacobsoni were collected from worker honeybees in February and September and also from the final (bee) brood and were analysed for 9 enzyme activities. The invertase activity was 2.5-fold as great as the amylase activity in February and September specimens but was similar to the amylase activity in mites taken from brood. The amylase activity was moderately high in all mites. Protease activity was highest in the mites from bee brood and lowest in the winter mites. Cellulase and especially exoglucanase activities were observed. Chitinase activity was higher in the winter than in the autumn mites. Lipase and alkaline and acid phosphatase activities were also detected; the acid phosphatase activity was 4 times as high in autumn as in winter mites. The differences in enzyme activities may be related to seasonal and developmental differences in the protein and carbohydrate composition of bee blood.

BARABANOVA, V.V. (1984) [Intestinal proteolytic activity in female Varroa jacobsoni.] Vestnik Zoologii No. 1 : 69-72 [Ru, B, AA/86]
Proteolytic activity in isolated intestines was determined at various developmental stages. The results showed that the proteases are cathepsin-like. No proteolytic activity was found in the Malpighian tubules. Low total activity seems to be related to the high amino acid content of the haemolymph.

NEPOMNYASHCHIKH, V.A. (1981) [The interaction of motivation and rhythms in the temporal regulation of behaviour patterns in Varroa jacobsoni.] Doklady Akademii Nauk SSR 258(6) : 1508-1510 [Ru, B, AA1274/83]
Honeybee pupae with V. jacobsoni attached to them were removed from combs and a total of 34 mites were studied continuously under a microscope for periods of 3-8 h. The rhythms studied were two phases of the mite's feeding behaviour, a searching phase when the mite makes repeated attempts to penetrate the host cuticle with its chelicerae, and a feeding phase recognizable by the movements of the intestine visible through the mite's integument. Feeding lasted from 0.1 to 15 min and the intervals between successive attempts to feed varied from 4 min to 3 h in the same mite. It is suggested that there is an underlying 'oscillator' with a regular rhythm of feeding behaviour, but that there is a threshold for the appearance of the searching phase. A rise in the level of feeding motivation leads to a fall in the threshold, but when the searching phase culminates in feeding the threshold rises temporarily and several rhythmic periods of the 'oscillator' are missed.

SADOV, A.V.; GORBATOV, V.A.; GROBOV, O.F. (1979) [Auto-radiography as a means of determining the amount of honeybee haemolymph in the diet of female Varroa mites.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noi Veterinarii No. 34 : 56-59 [Ru, B, AA628/81]
Bees were fed a 0.001% solution of ^{3}H-timidin in syrup (timidin is a complex with 4 nucleosides, a precursor of DNA). Each bee carried 1-3 V. jacobsoni. Autoradiographs were made of the haemolymph and other tissues of both bees and mites, using smears and sections made 24, 48, 72 and 96 h after feeding. Radioactivity was detected in the midgut, Malpighian tubules and muscles of the Varroa after 24 h, and in the cuticle of the mite after 48 h. After 96 h the marker was accumulating in the tissues of the mite, especially in the cuticle and fatty tissues.

TEWARSON, N.C.; ENGELS, W. (1982) Undigested uptake of non-host proteins by Varroa jacobsoni. Journal of Apicultural Research 21(4) : 222-225 [En, B, AA973/83]

3.34 continued

The nutrition of V. jacobsoni involves the macromolecular resorption of proteins. Immuno-techniques confirmed the presence of undegraded Apis mellifera proteins in the blood of adult female V. jacobsoni and protonymphs taken from infested laboratory colonies of A. m. carnica. Undegraded proteins were also present in newly laid eggs. Bovine serum albumin injected into adult worker honeybees was also subsequently detected in the haemocoel of female mites which had fed on the injected bees for 12-48 h. It is suggested that the V. jacobsoni digestive tract lacks the proteolytic enzymes necessary for breakdown of ingested proteins.

TEWARSON, N.C.; JANY, K.D. (1982) Determination of proteolytic activity in Varroa jacobsoni, an ectoparasitic hemophagous mite of honey bees (Apis sp.). Apidologie 13(4) : 383-389 [En, de, fr, B, AA1280/83]

In previous studies it was shown by immunotechniques that female Varroa jacobsoni feeding on honeybees resorb the honeybee's blood proteins without digesting them. The same proteins can also be detected in the mite's eggs. In order to check this undegraded resorption of host proteins, a study of proteolytic activity in V. jacobsoni was carried out using homogenates of whole female mites in Tris-HCl buffer (pH 8.2). Low proteolytic activity could be detected only by means of very sensitive methods using synthetic substrates, and there were also indications that Apis blood contains a protease inhibitory factor. The possible significance of macromolecular resorption of proteins in the life cycle of V. jacobsoni is discussed.

TEWARSON, N.C. (1983) Nutrition and reproduction in the ectoparasitic honey bee (Apis sp.) mite, Varroa jacobsoni. Dissertation zur Erlangung des Grades eines Doktors der Naturwissenschaften. Eberhard-Karls-Universität, Tübingen, German Federal Republic : ix + 71 pp. + lxvi [En, B, AA627/84]

The volume of larval Apis mellifera blood ingested by young mites varied from 0.86 µl in 1.5 h to 1.50 µl in 48 h, but an increase in feeding time was not significantly correlated with an increased meal volume. Using immunological and electrophoretic methods, it was shown that honeybee blood proteins passed into the mite's blood as whole macromolecular proteins, without any significant digestive degradation. These proteins were later detected in oocytes developing in mites, and in freshly laid eggs. In the latter, 7 proteins from honeybee blood, and one other protein, were identified as vitellogenins. Enzyme assays of the Varroa midgut revealed only a very weak proteolytic activity; the only enzyme identified was exocarboxypeptidase-A. Experimentally offered vertebrate protein (bovine serum albumin) was also found intact in the mite's blood. The results indicate that this particular host-parasite relationship is highly specialized.

3.35 REPRODUCTION

AKIMOV, I.A.; YASTREBTSOV, A.V. (1985) [Reproductive system of Varroa jacobsoni. II Male reproductive system and spermatogenesis.] Vestnik Zoologii No. 2 : 63-69 [Ru, B]

Reproductive system of V. jacobsoni male is represented by horseshoe-shaped testicles, paired vas deferens, ejaculatory duct and unpaired accessory gland. Five structurally distinct cell types are recognized in the accessory gland. Germarium absence is shown in adult male

3.35 continued

testicles, so that reproductive capacity realization depends on qualities acquired during instar development. No meiosis takes place during spermatogenesis. During its life, a male produces c. 600 spermatids (prespermatozoa). Spermatogenesis is completed at the stage of spermatids, spermiogenesis continues within female's sacculus foemineus. Adult male activity is restricted to reproduction, other important organic functions are respectively suppressed. Male's chelicerae are adjusted for copulation only and cannot bear any other functions. Reproductive system development during male nymphal stages is strongly connected with feeding on the bee brood.

BURTON, V.I. (1982) [Multiplication of mite, and cell size.] Pchelovodstvo No. 4 : 18 [Ru, B]

CAVICHIO ISSA, M.R.; GONÇALVES, L.S. (1985) Technique for inducing oviposition in the acarid *Varroa jacobsoni* under laboratory conditions. Page 69 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Several methods were tested for rearing *Varroa* outside the bee colony, including the use of beeswax cells. The best results were obtained by taking mites from recently sealed larvae and placing them in wax queen cups along with last stage larvae; the cells were then sealed with beeswax. The temperature used was 34°C and RH 85-90%. In 129 artificial cells containing drone larvae, 66 left a total of 82 descendants. In 39 cells containing queen larvae, 4 left a total of 4 descendants, and in 58 cells containing worker larvae, 17 left a total of 19 descendants.

FREMUTH, W. (1985) Einfluss der Temperatur auf die Wirts-Parasit Beziehung Biene-*Varroa* Milbe. [Influence of temperature on the host-parasite relationship between honeybees and *Varroa*.] Apidologie 16(3) : 211-212 [De, B]

Measurements of the brood nest temperature of bee colonies in 1983-1984 showed seasonal variations. In several experiments the influence of temperature variation on the development of bees, especially on the capping period and the reproductive behaviour of *V. jacobsoni*, was studied. Three temperatures were examined: 30°, 32.5° and 36°C. There was a significant prolongation of the pupal stage of the bees at lower temperatures, and the optimum reproduction of the mite occurred at 32.5°C. A combined effect of the extended capped period and optimal reproduction conditions at lower brood nest temperatures could be postulated.

GROBOV, O.F.; MIKITYUK, V.V. (1981) [Effects of some chemosterilants on female *Varroa* mites and on honeybees. Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 62-65 [Ru, B, AA1281/84]

In laboratory experiments various chemosterilants (alkylryls, homologues of alkyl compounds, and cytotoxic antibiotics) were effective in sterilizing *Varroa* females. However, they were also toxic to honeybees. Thus, hexamethyltriphosphamide (HMPA) topically applied to the integuments of both mites and bees had a high sterilizing and somatic activity. Doses of 0.1×10^{-3} mg HMPA decreased egg laying by *Varroa* by 55%, doses of 2×10^{-3} mg and 100×10^{-3} mg per mite decreased lifespan by 36.8% and 86%, respectively. A residual effect of HMPA was also observed. A high efficacy of thiophosphamide-triethylene and of PA18 and PA25 was also observed, but all these preparations were toxic to bees.

3.35 continued

HÄNEL, H. (1983) Effect of JH-III on the reproduction of Varroa jacobsoni. Apidologie 14(2) : 137-142 [En, de, fr, B, AA944/84]

JH-III was tested on mites in sealed cells containing honeybee larvae and pupae; when sealed fifth instar larvae were treated topically with the hormone there was a significant increase in the number of Varroa offspring compared with controls. In a further test, JH-III was applied to sealed cells into which a Varroa mite was then introduced; these mites produced significantly more offspring than untreated controls. Toxicity of JH-III to honeybees was tested by spraying solutions of it on to groups of caged workers; mortality in these groups was not significantly different from that of groups sprayed with water or solvent.

IFANTIDIS, M.D. (1983) Ontogenesis of the mite Varroa jacobsoni in worker and drone honeybee brood cells. Journal of Apicultural Research 22(3) : 200-206 [En, B, AA614/84]

Ontogenesis of the mite V. jacobsoni was observed at 4-h intervals in brood cells of the honeybee Apis mellifera cecropia. Between July and November 1981, in the region of Thessaloniki, 241 worker and 107 drone cells infested with fertile mites were examined in the post-capping period. A macroscopic distinction between the sexes was recorded photographically as early as the first mobile phase of mite ontogenesis. In cells containing either worker or drone brood, egg-laying by the mite began about 60 h after the cell was capped and one egg was laid every 30 min. Normally the offspring included only one male, which developed from an egg laid about 96 h after capping. Ontogenesis lasted 7.5 days in the female Varroa and 5.5 days in the male. The mite can lay at most 7 eggs in a drone cell and 6 in a worker cell.

IFANTIDIS, M.D. (1984) Parameters of the population dynamics of the Varroa mite on honeybees. Journal of Apicultural Research 23(4) : 227-233 [En, B, AA972/85]

The population dynamics of V. jacobsoni were studied in colonies of Apis mellifera cecropia in the region of Thessaloniki, Greece. The reproductive rate of the mite was estimated by examining the progeny of 364 females in worker cells and 131 in drone cells containing pupae with dark eyes and light brown thorax (i.e. 9 days after the worker cells and 10 days after the drone cells were sealed). The proportions of non-egg-laying mites on worker and drone brood were c. 19% and 4%, respectively. The reproductive rate was 2.92 for mites in worker cells (total progeny 1066) and 3.66 for mites in drone cells (total 480). The rate for female progeny reaching adulthood from each original female mite, for a single passage through the brood cells, was 0.71 for mites in worker cells and 1.70 for mites in drone cells.

MIKITYUK, V.V. (1979) [Reproductive capacity of female Varroa mites.] Pchelovodstvo No. 9 : 21 [Ru, B, AA986L/80]

MURAVSKAYA, A.I. (1982) [Assessment of the reproductive capacity of female Varroa jacobsoni.] Veterinariya, Moscow, USSR No. 2 : 49-54 [Ru, B, AA238/83]

Large numbers of cells of drone and worker brood of known age were examined at daily intervals. Varroa mites entered cells containing larvae and remained passive until the cells were sealed. The mites then began to move and to suck blood of the larvae. The first eggs were laid on about the 12th day on worker brood and on about the 14th day on drone

3.35 continued

brood. Each mite laid an egg each day for 5 days on worker brood, and for 6 days on drone brood. On bee brood 18 days old, the first mite eggs to be laid had developed into males and females of the next generation.

RITTER, W.; DE JONG, D. (1984) Reproduction of *Varroa jacobsoni* O. in Europe, the Middle East and tropical South America. Zeitschrift für Angewandte Entomologie 98(1) : 55-57 [En, de, B, AA572/85]

In an examination of brood from a comparatively small number of infested colonies over a period of 4 years infestation by *V. jacobsoni* was higher in drone cells than in worker cells. In colonies in the German Federal Republic and in Turkey about a quarter of the iRepublic and in Turkey about a quarter of the infested worker cells contained no reproductive mites; in Brazil (Africanized bees) the figure was 57%. A similar result was found in one colony of *A. m. ligustica* in Brazil.

RUTTNER, F.; MARX, H.; MARX, G. (1984) Beobachtungen über eine mögliche Anpassung von *Varroa jacobsoni* an *Apis mellifera* L. in Uruguay. [Observations on a possible adaptation of *Varroa jacobsoni* to *Apis mellifera* L. in Uruguay.] Apidologie 15(1) : 43-62 [De, en, fr, B, AA961/85]

Nine honeybee colonies at an experimental station in Uruguay were monitored for 2 years. The initial *Varroa* infestation is described as "moderate to heavy"; mites were present in 2-34% of capped brood cells (mean 18.4%). The colonies were not treated, but after 2 years the mean infestation level had decreased to 5.5% (ranging from 0 to 13%). This result is explained by the low reproductive rate of female mites in worker cells; 60-90% of these females did not produce offspring. This is in marked contrast to the figure of 20% found in studies in Europe. *Varroa* reproduction in drone cells in colonies in Uruguay was similar to that in colonies in Europe. In Uruguay generally, *Varroa*-infested colonies are not treated by beekeepers and they do not seem to be greatly weakened by the presence of the mites.

SCHULZ, A.E. (1984) Reproduktion und Populationsentwicklung der parasitischen Milbe *Varroa jacobsoni* Oud. in Abhangigkeit vom Brutzyklus ihres Wirtes *Apis mellifera* L. (1. Teil). [Reproduction and population development of the parasitic mite *Varroa jacobsoni* in relation to the brood cycle of its host *Apis mellifera* (Part 1).] Apidologie 15(4) : 401-420 [De, en, fr, B]

In naturally infested worker brood there were 1.82 female deutonymphs per fertile *Varroa*. In drone brood, 95% of the mites were fertile, and in worker brood 73%; overall, 78% of those that reproduced did so only once, and the rest twice. Reproductive rate on drone brood was 2.9-3.2 adult daughters per mite, and on worker brood 1.6. In May, mites preferred drone brood 8.6 times more than worker brood. Mites remain fertile for 50 days during the summer.

SHANIDZE, M.G. (1979) [Egg laying of the female *Varroa* mite.] Pchelovodstvo No. 11 : 20-21 [Ru, B, AA1013/81]

Four types of egg were identified; the type which predominated from February to May was oval, white, 0.47 x 0.58 µm, with a larva forming within the membrane. From June to October the main type was yellowish-white, round, soft, 0.41 x 0.48 µm, with a yellow mass inside. Fewer eggs were laid in spring (2-5 eggs, sometimes 9/cell).

3.35 continued

SULIMANOVIĆ, D.; RUTTNER, F.; PECHHACKER, H. (1982) [The biology of reproduction in Varroa jacobsoni.] Honeybee Science 3(3) : 109-112 [Ja, en, B, E1584, AA623L/83]

TEWARSON, N.C. (1983) Fortpflanzungsphysiologische Untersuchungen an Varroa jacobsoni: Eiablage und Schlüpfen der Erstlarve. [Study on the reproductive physiology of Varroa jacobsoni: egg laying and hatching of the first nymphal stage.] Allgemeine Deutsche Imkerzeitung 17(9) : 277-280 [De, B, AA1345L/85]

3.36 TAXONOMY

DELFINADO, M.D.; BAKER, E.W. (1974) Varroidae, a new family of mites on honey bees (Mesostigmata: Acarina). Journal of the Washington Academy of Sciences 64(1) : 4-10 [En, B, AA228/75]

An examination of the mite V. jacobsoni Oudemans (type-species of Varroa), infesting honeybees in SE Asia, showed that it possessed characteristics which did not fit the family Laelapidae to which it had been assigned. V. jacobsoni is redescribed with diagrams: Euvarroa sinhai, a new species from India and parasitic on honeybees, is also described. It is proposed that these mites should be placed in a separate family, Varroidae.

SAMŠIŇÁK, K.; HARAGSIM, O. (1975) The taxonomic placement of the genus Varroa Oudemans, 1904 (Acari, Dermanyssidae). Folia Parasitologica 22 : 189-191 [En, ru, B, AA260L/77]

A subfamily Varroinae has been erected within the family Dermanyssidae.

3.4 HONEYBEES INFESTED WITH VARROA JACOBSONI

3.41 DIAGNOSIS

ABEILLE DE FRANCE ET L'APICULTEUR (1983) Essai de dépistage de la varroase en Alsace. [Diagnostic tests for varroa disease in Alsace.] Abeille de France et l'Apiculteur No. 672 : 225-226 [Fr, B, AA578L/85]

BARBATTINI, R.; MARCHETTI, S.; D'AGARO, M. (1984) Risultati comparativi di diverse metodiche diagnostiche della varroasi. [Comparative results of various methods for diagnosing varroa disease.] Pages 68-77 from "Apicoltura sana - agricoltura produttiva. Atti del Convegno Internazionale dell'Apicoltura, Lazise, 29 settembre - 2 ottobre, 1983", Milan, Italy : Studio Edizioni [It, en, B, AA953/85]

The following methods for diagnosing *Varroa* infestations were compared using 25 healthy colonies and 15 infested ones; analysis of hive residues after winter, treatment with Folbex-VA, inspection of adult bees and drone brood. With heavy infestations all 4 methods gave good results, but inspecting hive residues was the cheapest. With a low level of infestation the most efficient method was to use Folbex-VA.

BREM, S. (1980) Beitrag zur Varroatosediagnostik. [Diagnosis of varroa disease.] Berliner und Münchener Tierärztliche Wochenschrift 93(6) 114-116 [De, en, B, AA1008/81]

The biology of *V. jacobsoni* is described briefly. Early diagnosis by the inspection of hive debris is useful; a 2.8-mm wire mesh is inserted between the winter cluster and the hive floor. Some (10-20 g) of the small debris which is collected is then examined. Separation of mites can be achieved by flotation of the debris in ethanol - wax, pollen, propolis particles, etc. sink, while mites and chitin particles float.

CHERNEVSKIĬ, P. (1978) [A portable box for diagnosing varroa disease.] Pchelarstvo 76(9) : 26-27 [Bg, B, AA258L/80]

DANIELIAN, S.G.; NALBANDIAN, K.M. (1980) [Device for contemporary diagnosis.] Pchelovodstvo No. 10 : 24 [Ru, B]

Of *V. jacobsoni* mites in honeybee colonies; there is a diagram of the device.

DE JONG, D.; ROMA, D. DE A.; GONÇALVES, L.S. (1982) A comparative analysis of shaking solutions for the detection of *Varroa jacobsoni* on adult honeybees. Apidologie 13(3) : 297-303 [En, de, fr, B, AA1279L/83]

A plastic bottle with a constriction in the middle acts as a shaking container; it contains a wire screen with holes 3 mm square. On shaking infested bees in a liquid in the container, the mites become detached and pass through the screen into the neck of the inverted bottle. Of the 7 liquids tested at various concentrations, the most effective, convenient and economic was a 25% aqueous solution of ethanol or of isopropyl alcohol. Hand shaking of infested bees in one of these solutions for 1 min removed on average 92% of the mites; mechanical shaking in a rotary shaker for 30 min was 100% effective.

FUCHS, S. (1985) Untersuchungen zur quantitativen Abschätzung des Befalls von Bienenvölkern mit *Varroa jacobsoni* Oudemans und zur Verteilung des Parasiten im Bienenvolk. [Quantitative diagnosis of the infestation of bee hives by *Varroa jacobsoni* Oud. and distribution of the parasitic mite within

3.41 continued

the hives.] Apidologie 16(4) : 343-367 [De, en, fr, B]
Two simple methods for estimating the infestation level of a colony are compared, and the accuracy of each is assessed.

HARTMANN, S. (1982) Ergebnisse der Wintergemüll-Untersuchung auf Varroa jacobsoni im Regierungsbezirk Stuttgart. [Results of the examination of winter [hive] debris for Varroa jacobsoni in the Stuttgart district.] Bienenpflege No. 11 : 222-224 [De, B, AA1290/83]
In an examination of debris from 45 203 colonies, Varroa mites were found in samples from 921 colonies. The results were analysed by district (Kreis) though rather few samples were submitted from some. The percentage of infested colonies varied among the 12 districts; in central and eastern ones (where there is little migratory beekeeping) there was a very low infestation or none at all, but in parts of the north and west up to 8% of colonies examined were infested. However, the number of mites per sample was usually low, suggesting that most of the colonies were newly infested.

KAMBUROV, G.; KIRILOV, N. (1981) [More precise diagnosis.] Pchelarstvo 79(3) : 6-7 [Bg, B]

KASHKOVSKIǏ, V.G.; USTINENKOVA, S.N. (1982) [Observation beehive for diagnosis of Varroa jacobsoni infestation.] Pchelovodstvo No. 10 : 19-20 [Ru, B]

KOSTECKI, R.; JELIŃSKI, M. (1983) Diagnostyka inwazji Varroa jacobsoni u pszczoły miodnej. [Diagnosis of Varroa jacobsoni infestation of the honeybee.] Zycie Weterynary jne 58(3) : 113-115 [Pl, B, AA252L/85]

KUDRYAVTSEV, E.A.; SIMENITSKIǏ, M.A.; SMIRNOV, A.M. (1976) [Diagnosis of Varroa infestation of honeybees with the aid of Varroatin.] Pchelovodstvo No. 2 : 17-18 [Ru, B]

POLTEV, V.I.; SADOV, A.V.; MEL'NIK, V.N. (1981) [Examination of honeybees for Varroa.] Veterinariya, Moscow, USSR No. 2 : 51-54 [Ru, B, AA1331/82]
It is recommended that 50-100 bees per hive should be examined for the mites in the summer. The bees are transferred to a wire cage which is shaken in a vessel containing a 1% solution of soda, lye or washing powder at 60°C. The mites are dislodged and after straining through muslin may be counted. This is a more reliable method than searching the hive floor. It is claimed that if 20 mites are found on 100 bees, it means that the colony will decline, and 50 mites per 100 bees means that the colony will probably be killed.

RITTER, W.; RUTTNER, F. (1980) Diagnoseverfahren. [Methods of diagnosis [of Varroa jacobsoni infestations].] Allgemeine Deutsche Imkerzeitung 14(5) : 134-138 [De, B, AA1028/81]
In winter, mites were found by immersing dried hive debris in alcohol; the mites and pieces of chitin floated, whilst wax and other detritus sank. Most mites fell to the hive floor in February and March. Mite mortality was significantly higher from the end of July to mid-September than in other summer months. In summer, diagnosis in moderately and

3.41 continued

strongly infested colonies was made by examination of drone brood cells at the edge of the frame.
For definite diagnosis in weakly infested colonies it is suggested that the mites be killed with a suitable acaricide (but preferably only in spring and autumn); samples of bees should be taken only from open brood comb.

TARKHANOV, B.V. (1981) [Diagnosis of the degree of mite infestation of honeybees.] Pchelovodstvo No. 6 : 27-28 [Ru, B]
V. jacobsoni in brood cells.

3.42 BIOLOGY

BAARS, A.J.; DRIESSEN, O.M.J. (1984) Aryl hydrocarbon hydroxylase and glutathione S-transferase activity in the Varroa mite and the honeybee. Journal of Apicultural Research 23(1) : 37-39 [En, B, AA1285/84]
Aryl hydrocarbon hydroxylase and glutathione S-transferase activity was determined in post-mitochondrial fractions of homogenates of the mite V. jacobsoni and the honeybee (Apis mellifera). Aryl hydrocarbon hydroxylase activity in the mite was about a third of that found in the honeybee, whereas the glutathione S-transferase activity was similar in the two. The results obtained may be relevant to the screening of acaricides to control the mite.

BRETSCHKO, J. (1980) Varroatose aus biologischer Sicht. [Varroa infestation from a biological viewpoint.] Allgemeine Deutsche Imkerzeitung 14(12) : 365-368 [De, B, AA240/82]
Hive populations and incidence of varroa disease were recorded from October until the following July at several apiaries in Tunisia. During the beginning of the spring build-up of colony population, there were fewer mites in colonies with queens 0-1 yr old than in colonies with older queens. Colonies with fewer mites increased their size more rapidly. It is concluded that in strong colonies a 10-20% level of infestation was not harmful.

BYZOVA, YU. B.; PETROVA, A.D.; TATSIĬ, V.M.; EMEL'YANOVA, O. YU. (1982) [Respiration of honey bees (Apis mellifera L.) under the influence of varroatosis.] Doklady Akademii Nauk SSR 263(1) : 235-238 [Ru, AA1286/84]; also in Doklady Biological Sciences 263(1-6) : 229-231 (1982) [En, B]
Weight loss during honeybee metamorphosis was 19% of total weight in healthy bees, and 25% in bees parasitized by Varroa. During the second half of pupal development oxygen uptake increased considerably in parasitized bees (146.4 ml/g body weight, compared with 128.8 ml/g in controls). This is probably because of restlessness of the pupae, resulting also in damage to the integument. Infestation of wintering colonies produced a lower (by c.25%) respiration rate and disrupted thermoregulation in the cluster. It is postulated that these effects accumulate from generation to generation, causing progressive deterioration of the colony.

CHOI, S.Y.; WOO, K.S. (1974) [Studies on the bionomics of bee mite Varroa jacobsoni Oudemans and its chemical control. II.] Research Reports of the Office of Rural Development, Suwon, Korea (Livestock) 16 : 69-76 [Ko, en, B, AA839/76]
Infestation of honeybees by V. jacobsoni was greater in sealed brood than

3.42 continued

adult bees during the brood-rearing season, but infestation of adults increased thereafter. Pupal weight was greatly reduced by infestation; the presence of 6 mites on a pupa caused a 10% reduction.
Hyang-Su No. 1, a mixture of plant origin for controlling mites on bees, applied at 2-3 ml per comb just before cells were sealed reduced pupal brood weight by 5%. It is therefore not recommended for use during the main brood-rearing season.

DE JONG, D.; DE JONG, P.H.; GONÇALVES, L.S. (1982) Weight loss and other damage to developing worker honeybees from infestation with *Varroa jacobsoni*. Journal of Apicultural Research 21(3) : 165-167 [En, B, AA971/83]
The type and degree of damage to adult workers of *Apis mellifera* from infestation with the parasitic mite *V. jacobsoni* during development was investigated. Mean weights of infested bees upon emergence as adults were from 6.3% to 25% less than for healthy bees. Mean % weight loss was correlated at a high level of significance with the number of mites in the cell. Only 6% of infested bees showed obvious physical deformation in the form of wing damage.

DE JONG, D.; DE JONG, P.H. (1983) Longevity of Africanized honey bees (Hymenoptera: Apidae) infested by *Varroa jacobsoni* (Parasitiformes: Varroidae). Journal of Economic Entomology 76(4) : 766-768 [En, B, AA949/84]
In Brazil, uninfested Africanized honeybees lived for an average of 27.6 days; bees infested by *V. jacobsoni* during pupal development lived on average for only 13.6 days. Bees infested with 2 or more mites lived for 9 days. The number of mites per bee was negatively correlated with length of life and weight of the bee at emergence. There was no significant correlation between weight at emergence and length of life in either infested or uninfested bees, therefore the shorter lifespan of infested bees was not merely a secondary result of reduced adult weight.

DE JONG, D.; GONÇALVES, L.S.; MORSE, R.A. (1984) Dependence on climate of the virulence of *Varroa jacobsoni*. Bee World 65(3) : 117-121 [En, B, AA958L/85]
The effects of *V. jacobsoni* infestations have not been so severe in tropical climates as in temperate ones.

DOLEJSKY, W.; SCHLEY, P. (1980) Ein mathematisches Simulationsmodell zur Abschätzung der Populationsentwicklung im Bienenvolk (*Apis mellifera* L.) nach Befall mit der Milbe *Varroa jacobsoni* Oud. [A mathematical simulation model to estimate population development in a honeybee colony after infestation with the mite *Varroa jacobsoni*.] Zentralblatt für Veterinärmedizin, B 27(9-10) : 798-805 [De, en, es, fr, B, AA1415/81]
The populations of bees and of *Varroa* mites were studied using a simulation model with time-dependent parameters. A Fortran program was used to obtain numerical solutions to two differential equations and one integro-differential equation describing the numbers of bees and of mites. Actual data fitted the model well, and results are presented graphically.

DOMATSKAYA, T.F.; GROBOV, O.F. (1980) [Haemolymph of honeybees infested with *Varroa jacobsoni* mites.] Pchelovodstvo No. 7 : 18-19 [Ru, B]

3.42 continued

DOMATSKAYA, T.F. (1980) [Protein and nitrogen contents of the blood of honeybees infested with Varroa jacobsoni.] Veterinariya, Moscow, USSR No. 11 : 47 [Ru, AA943/82]

The amounts of protein and residual nitrogen in the blood of healthy honeybees and of bees infested with Varroa jacobsoni were determined in each month between May and September. It is concluded that infestation by these mites impedes protein metabolism and leads to an increase in the level of non-protein nitrogen. Feeding infested colonies with a protein supplement is recommended.

GLINSKI, Z.; JAROSZ, J. (1984) Alterations in haemolymph proteins of drone honey bee larvae parasitized by Varroa jacobsoni. Apidologie 15(3) : 329-337 [En, de, fr, B, AA960/85]

Protein fractions in healthy drone brood and in drone brood parasitized by V. jacobsoni were compared by electrophoresis. In parasitized brood the total protein content was lower and was related to the numbers of Varroa. Electrophoretic patterns and densities of proteins were also altered, especially those of the low mol wt cathodal fractions. It is suggested that the changes could be due to protein depletion in the host larvae, but that they may be the result of biochemical changes following the release of toxic substances by the mite into the host's blood.

GONÇALVES, L.S.; DE JONG, D.; NOGUEIRA, R.H. (1982) Infestation of feral honey bee colonies in Brazil by Varroa jacobsoni. American Bee Journal 122(4) : 249-251 [En, B, AA620/83]

In an examination of 32 feral colonies in the state of São Paulo, 29 contained V. jacobsoni. Infestation levels of adult bees and of worker brood and drone brood are reported. In one area, the level of infestation was significantly lower than that of managed colonies.

In a congested group of feral colonies, the level of infestation was higher than in colonies which were further apart.

JANI, M. (1982) Diagnosticka varroatózy bez cemikálií. [Diagnosis of Varroa jacobsoni infestation without chemicals.] Včelár 56(6) : 138 [Sk, B]

NIKOL'SKIĬ, O.R.; PRISMOTROVA, N.N.; KUZINA, N.I. (1980) [Prognosis of the epizootological condition of honeybees affected by varroa disease.] Pages 13-17 from "Bor'ba s boleznyami pchel na dal'nem vostoke", Blagoveshchensk, USSR; Khabarovskoe Knizhnoe Izdatel'stvo" [Ru, B, AA574/82]

The number of V. jacobsoni mites in honeybee colonies was estimated by counting the number on 100 bees. Three categories of infestation were recognized: weakly infested, 1-10 mites; moderately infested, 11-20 mites; strongly infested, over 20 mites per 100 bees. For colonies killed by Varroa in the Primorskiĭ region, counts varied from 21 to 208; for colonies that had not succumbed, from 4 to 19 mites per 100 bees. The author suggests that if a colony has from 15 to 20 mites per 100 bees in August or September, considerable deaths can be expected in late autumn and winter.

OKU, K.; HARA, N.; SANO, H. (1983) [The occurrence of wing abnormalities in honeybees.] Honeybee Science 4(3) : 109-110 [Ja, en, B, AA621/84]

In an inspection of 1861 colonies in 81 apiaries in Shizuoka Prefecture, central Japan, workers with distorted wings were found in 80% of apiaries (46% of colonies). Laboratory experiments suggest that such deformation results from infestation with V. jacobsoni.

3.42 continued

POLTEV, V.I. (1978) [Characteristics of the course of varroa disease of honeybees.]
The full entry, with annotation, is in 3.31.

RITTER, W.; LECLERCQ, E.; KOCH, W. (1984) Observations des populations d'abeilles et de Varroa dans les colonies à différents niveaux d'infestation. [Observations on the populations of honeybees and of Varroa in colonies with different levels of infestation.] Apidologie 15(4) : 389-400 [Fr, en, de, B]

SADOV, A.V. (1978) [Effect of the mite Varroa jacobsoni on biochemical values of the honeybee.] Veterinariya, Moscow, USSR No. 9 : 66-68 [Ru, B, AA964/80]
In workers and drones parasitized by females of V. jacobsoni, there is a rapid decrease in nucleic acid content of muscle tissue in comparison with unparasitized bees, and the total protein content of the haemolymph is 15-30% less. Such losses, which occur in bees of different ages, result from the consumption of haemolymph by the mites. Where bees are deficient in protein and its fractions, it is necessary to feed supplementary protein in spring and autumn.

SCHATTON, K. (1985) Veränderungen des Hämolymphprotein Spektrums von Apis mellifera als Folge einer Parasitierung durch Varroa jacobsoni. [Changes in the haemolymph protein spectrum of Apis mellifera as a result of parasitization by Varroa jacobsoni.] Diplomarbeit der Fakultät für Biologie, Universität Tübingen, German Federal Republic : vi + 57 pp. [De, B, AA/86]
Changes in individual infested workers were monitored during ontogenesis. The total protein content in the haemolymph, measured by the Bradford method, decreased; using the SDS-PAGE method, the protein content was found to decrease in some fractions and to increase in others. Where the infestation level was 6 or more mites per bee, newly emerged adults were 30% lighter than controls and had more deformities.

SMIRNOV, A.M. (1978) [Effect of varroatin on queen honeybees.] Veterinariya, Moscow, USSR No. 1 : 68-71 [Ru, B, AA245/81]
In applications in hives to prevent Varroa infestations, 12 sprayings with an aerosol preparation of varroatin over the first 2 years of a queen's life did not affect her survival or egg-laying capacity. The sex ratio and development of the offspring remained unchanged. In contrast, phenothiazine applied as a smoke in 6 similar doses decreased the egg-laying capacity of queens and 8 doses killed one-third of queens. In colonies treated with varroatin, viable queens, workers and drones emerged from sealed brood. No larvae or pupae were removed by the workers.

WEINBERG, K.P.; MADEL, G. (1985) The influence of the mite Varroa jacobsoni Oud. on the protein concentration and the haemolymph volume of the brood of worker bees and drones of the honey bee Apis mellifera L. Apidologie 16(4) : 421-435 [En, fr, de, B]
The protein concentration in the haemolymph of infested worker brood decreased with age, but in drone brood it increased, and there was a relationship between the amount of the increase and the intensity of parasitization. In both castes, haemolymph volume decreased, the decrease being related to the number of mites per cell. The decrease

3.42 continued

was smaller in drone pupae than in worker pupae. The total protein content of worker pupae decreased rapidly after infestation and was related to the number of mites. The correlation was not found in drone pupae, although there was a decrease in protein content.

YONEMURA, H. (1983) [Wing abnormalities in honeybees caused by Varroa] Honeybee Science 4(3) : 111-112 [Ja, B, AA622L/84]

ZAPOL'SKIKH, O.V. (1983) [Haemocytes of drone brood affected by varroa disease.] Pchelovodstvo No. 9 : 17-18 [Ru, B, AA252/86]

Morphological changes in the haemocytes of drone honeybee pupae infested by V. jacobsoni are described. These include an increase in the number of vacuoles and disruption of the nucleus.

3.43 CONCURRENCE OF MICRO-ORGANISMS

BALL, B.V. (1985) Acute paralysis virus isolates from honeybee colonies infested with Varroa jacobsoni. Journal of Apicultural Research 24(2) : 115-119 [En, B, AA243/86]

Large amounts of acute paralysis virus (APV) were extracted from dead, field-collected samples of honeybees from Russia and the German Federal Republic. Virus isolates were compared to the British type strain. Particles of the 3 isolates were physically indistinguishable and closely related serologically, and each produced 3 well-defined protein bands of apparently identical mol wt on SDS polyacrylamide gels. In Britain APV has never been found to be associated with mortality in nature. In both Russia and Germany the occurrence of APV in dead field bees and brood was associated with infestation of the colonies by the mite V. jacobsoni. The possible role of the mite in APV infection of honeybees is discussed.

BALL, B..V. (1983) Der Zusammenhang zwischen Varroa jacobsoni und Viruserkrankungen der Honigbiene. [The association of Varroa jacobsoni with virus diseases of honeybees.] Biene 119(5) : 200-201 [De, B, E1594, AA931/84]; also in Allgemeine Deutsche Imkerzeitung (1983) 17(6) : 177-179

Evidence from several sources suggests that infestations of honeybee colonies by V. jacobsoni may be associated with acute paralysis virus (APV), and possibly other viral infections. In honeybees in the UK, APV is present at low levels in apparently healthy adult bees and does not cause mortality. It is postulated that multiplication of the virus is normally supressed, but that the presence of Varroa in some way affects this mechanism so that virus replication occurs.

BATUEV, YU.M. (1979) [New data on the paralysis virus.] Pchelovodstvo No. 7 : 10-11 [Ru, B]

Paralysis of Apis mellifera, with V. jacobsoni as possible vector.

CHERNOV, K.S. (1981) [Transmission of mycoses - an aspect of Varroa infestations.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 59-60 [Ru, B, AA240/85]

V. jacobsoni kept in petri dishes containing Aspergillus or Beauveria cultures at 26°C for 1-2 weeks became infected by the fungi and died in 1-3 days as a result of the mechanical effects of the spores and mycelia. An experiment to study the possibility of the transference of aspergillosis by Varroa to honeybees is described, but no results are given.

3.43 continued

GUZEVA, L.N. (1981) [Vector of pathogens of bacterial diseases of honeybees.] Pchelovodstvo No. 4/5 : 36 [Ru, B]
V. jacobsoni in the USSR.

HANKO, J. (1980) Polyparazitizmus: nozematóza, braulóza, varroatoza. [Polyparasitism: nosema disease and *Braula* and *Varroa*.] Včelár 54(5) : 115 [Sk, B]

HORN, H. (1984) Zum Zusammenhang zwischen *Varroa jacobsoni* und Bakteriosen bei der Honigbiene. [The relationship between *Varroa jacobsoni* and bacterial diseases of the honeybee.] Allgemeine Deutsche Imkerzeitung 18(10) : 328-329 [De, B, AA1338L/85]

LIAKOS, B.; SITAROPOULOU, N. (1984) Viral diseases of bees in Greece. Ellenike Kteniatrike 26(4) : 196-199 [En, Gr, B, AA621/86]
Sac brood disease was identified in 11 of 111 samples examined in 1983 at the Veterinary Institute at Thessaloniki. The increase of sac brood in Greece over the last 10 years is thought to be due to its transmission by *V. jacobsoni*. Paralysis, caused by a polymorphic virus 20-70 nm in size, appears in two forms. One exhibits symptoms related to the nervous system such as inability to fly and paralysis, the other causes morphological changes. Paralysis in both forms appears most regularly in apiaries in the Halkidiki and Thassos regions, especially in colonies collecting honeydew. Rickettsial disease was identified in 36 of 416 samples examined in 1980-83, and a polymorphic virus, 18-20 nm long, was isolated from bees with this disease.

SALIMOV, R.M.; KUTSENKO, YU. M.; KUMKOV, V.T. (1975) [Bacteriological and virological investigations in an area badly infested with *Varroa*.] Byulleten' Vsesoyuznogo Ordena Lenina Instituta Eksperimental'noĭ Veterinarii No. 21 : 61-62 [Ru, B, AA241/78]
Deaths of bees in some apiaries in the Primorskii region were thought to be due to a septic condition transmitted by *V. jacobsoni*. Tests of haemolymph from diseased bees and of suspensions made from *Varroa* taken from the affected apiaries indicated the presence of *Enterobacter hafnia*. Serological tests confirmed this diagnosis. Tests for viruses were negative.

SHABANOV, M. (1984) [Role of *Varroa jacobsoni* Oudemans as a carrier of microorganisms in honeybee colonies.] Acta Microbiologica Bulgarica 15 : 78-82 [Ru, B]
The mites show a marked preference for honeybee drone brood; they infect pupae and larvae with European foul brood. The cappings over the diseased larvae and pupae are slightly folded, flat and sunken. The dead larvae and pupae smell unpleasant and do not stick to the cell walls. The mass is not stringy; it spreads and has a granular consistency. Several bacilli were isolated from the diseased larvae and dead larvae, as well as from the mites.

3.44 RESISTANCE AND SUSCEPTIBILITY TO THE MITE

CREWE R.M. (1984) Natural resistance to *Varroa* in *capensis*? South African Bee Journal 56(4) : 86-87 [En, B, AA1347L/85]
Because of the shorter post-capping stage (9.6 days) than in European *A. mellifera* (12-12.5 days).

3.44 continued

KULINČEVIĆ, J.M. (1985) Differential survival of honeybee colonies infested by Varroa jacobsoni and breeding for resistance. Pages 73-74 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

The mite has been present in Yugoslavia since the early 1970s. Despite the use of chemical and other control measures, very high losses of honeybee colonies have occurred. However, in some untreated apiaries a few colonies were apparently coexisting with the mite. This fact indicates the possibility of breeding for resistance to, or for coexistence with V. jacobsoni.

The first steps in identifying apparently resistant colonies are described, and a first generation selected for resistance is compared with a control group of colonies.

KHOROSHILOV, V.G. (1975) [Races of bees.] Pchelovodstvo No. 8 : 14-15 [Ru, B, AA1059/76]

For winter hardiness and resistance to varroa mites.

KUZNETSOV, A.V.; KHOROSHILOV, V.G. (1980) [Performance of different honeybee races in Primor'e.] Pchelovodstvo No. 9 : 5 [Ru, B, AA899/81]

The number of hives in Primor'e has been declining, mainly as a result of varroa disease. Experiments over 2 years were designed to discover which of 6 races of bees were most resistant to nosema disease and to Varroa infestation. The results confirmed those of earlier studies and showed that in the Far East USSR, it is best to use the local bee and not races from other regions.

3.45 BEES OTHER THAN APIS MELLIFERA

3.45.1 Apis cerana

DELFINADO-BAKER, M.; KNOX, D. (1982) Infestations of Apis cerana indica colonies by Acarapis woodi and Varroa jacobsoni. American Bee Journal 122(8) : 592 [En, B, AA817/83]

Samples of bees and brood collected from 2 apiaries in Pakistan [specific locality not known] in May 1982 were examined. Female mites of V. jacobsoni were found in the brood cells. A. woodi was identified in the tracheae of adult bees. This mite was also identified in a sample of bees collected at Rawalpindi. This is the first report of acarine disease in Pakistan.

HARA, A. (1980) [Varroa jacobsoni - an ectoparasitic mite of the honeybee.] Honeybee Science 1(1) 17-20 [Ja, en, B, AA1349/80]

Colonies of Apis cerana japonica were examined for the presence of V. jacobsoni in the Tsushima islands, Japan, where there are no A. mellifera; only one mite (on a drone) was found during examinations of 573 bees. In an infested Apis cerana colony in Tokyo, 2% of bees had Varroa mites compared with 20% in a nearby Apis mellifera colony.

Mites were reared in the laboratory (35°C, RH 85%); egg laying was observed, and 2 nymphal stages lasted 8-11 days.

3.45.1 continued

KITAOKA, S. (1983) [Notes on previous Varroa infestations and the recent occurrence of deformed honeybees in Japan.] Honeybee Science 4(3) : 105-108 [Ja, en, B, AA620/84]

V. jacobsoni has probably been a parasite of Apis cerana for a long time, and on this bee species the effects of the parasitism are not severe. However, when this mite first infested Apis mellifera in Japan in about 1950, this species of honeybee had no defence mechaism. Severe damage to colonies in Japan resulted. In 1982 there was a high incidence of deformed workers in colonies in many apiaries, and this was correlated with the size of V. jacobsoni infestations in those colonies.

KOENIGER, N.; KOENIGER, G.; WIJAYAGUNASEKARA, N.H.P. (1981) Beobachtungen über die Anpassung von Varroa jacobsoni an ihren natürlichen Wirt Apis cerana in Sri Lanka. [Observations on the adaptation of Varroa jacobsoni to its natural host Apis cerana in Sri Lanka.] Apidologie 12(1) : 37-40 [De, en, fr, B, AA72/82]

Seven colonies were examined by opening capped brood cells; V. jacobsoni was found in all colonies. All of the 66 adult mites found on drone pupae had produced nymphs and young females, whereas no nymphs or eggs were found on worker pupae. If this is true in general for Apis cerana, it may be one of the reasons why the mite is less harmful to Apis cerana than to Apis mellifera, where Varroa reproduces on worker as well as on drone brood.

3.45.2 Wild bees

MIKITYUK, V.V.; SEDIN, I.F. (1980) [Spread of Varroa jacobsoni in an area with a high population of wild bees (Apoidea).] Trudy Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 52 : 101-103 [Ru, B, AA242/82]

Thirty species of wild bees were captured on plants near hives of honeybees known to be infested with Varroa; none of them were carrying Varroa, and no mites at all were found on 28 of the species. The mite Tortania harstia was found on Halictus quadricinetus and H. scabiosa. The results suggest that it is unlikely that wild bees contribute to the spread of Varroa.

3.5 GENERAL AND NON-CHEMICAL CONTROL

3.51 BIOLOGICAL TREATMENT (INCLUDING COLONY MANAGEMENT)

ABAKUMOV, A.M. (1980) [Treatment of frames during varroa disease.] Veterinariya, Moscow, USSR No. 2 : 40 [Ru, B, AA636/81]

Varroa mites are 4-9 times as numerous in drone comb as in worker comb; they are also more than twice as numerous in the lower parts of combs as in the upper. Therefore the building of drone comb was encouraged in the lower parts of frames, then the comb was cut out, so that the total number of mites to be treated by other means was reduced.

BREMER, J.E. (1982) Aufzucht guter Rasseköniginnen auch in Varroa-Gebieten auf einfachste und billigste Art für alle Imker. [Rearing good queens of pure race, even in areas with Varroa, is the simplest and cheapest solution for all beekeepers.] Biene 118(4) : 152-156 [De, B]

BRETSCHKO, J. (1983) Varroatose auch ein Problem der Bienenpflege. [Varroa disease is also a problem of bee management.] Bienenvater 104(2) : 48-50, 52-54 [De, B, AA942/84]

Levels of infestation were recorded in colonies, with or without treatment, in Tunisia and in Yugoslavia. The author thinks that control of the mite should not be entirely dependent on the use of chemicals; it is important to detect the presence of Varroa early. If infested drone brood is removed, mite populations are reduced. Tobacco smoke is also effective; any chemical treatment should not be carried out until the autumn. During the summer it is important to ensure that colonies have sufficient food, though a strong colony is not immune from attack.

GATINEAU, M. (1984) Le blocage de la ponte, lutte contre le Varroa? [Preventing egg-laying, a control measure against Varroa?] Abeille de France et l'Apiculteur No. 681 : 119-120 [Fr, B, AA574L/86]

KOENIGER, N.; SCHULZ, A. (1980) Versuche zur biologischen Therapie der Varroatose durch eine Kontrolle der frischgeschlüpften Bienen. [Experiments on a biological treatment of varroa disease by the control of all newly emerged bees.] Apidologie 11(2) : 105-112 [De, en, fr, B, AA235/82]

Results of experiments with 4 honeybee colonies agree with earlier reports that removal of infested brood effectively reduces the total varroa mite population.

KOENIGER, N. (1982) Drohnenbrut als Varroa-Falle. [Honeybee drone brood as a trap for varroa.] Biene 118(3) :103-104 [De, B]

KOOPMAN, J.P. (1984) Varroatose; een zoötechnisch bestrijdingssystem. [Varroa disease: a zootechnical system of control.] Tijdschrift voor Diergeneeskunde 109(12) : 522 [Nl, B]

MAUNG MAUNG NYEIN; ZMARLICKI, C (1982) Control of mites in European bees in Burma. American Bee Journal 122(9) : 638-639 [En, B, AA275/84]

In Burma the native host of V. jacobsoni is Apis cerana and that of Tropilaelaps clareae is Apis dorsata. Both mites were found in all mature Apis mellifera colonies examined. A treatment programme for 21 Apis mellifera colonies involved: confinement of the queen in a cage for 21 days; uncapping of dead brood; feeding with sugar syrup (which stimulates hive cleaning); fumigation with phenothiazine. Six colonies

3.51 continued

which suffered queen failure during the following 7 months were lost, but in the other 15 colonies the populations of both mites were reduced. After release the queens began to lay rapidly, and all 15 colonies increased and produced surplus honey (average 35 kg). The best time to carry out such an annual treatment is when brood rearing is at its lowest level.

MEL'NIK, V.N.; MURAVSKAYA, A.I. (1981) [Drone brood combs and Varroa jacobsoni infestations. Veterinariya, Moscow, USSR No. 4 : 50-51 [Ru, B, AA1333/82]

Drone comb or foundation is placed in the hive in spring and summer to attract Varroa mites. A total area of drone comb (on one or more frames) of 840-1680 cm^2 is sufficient for a single-chambered hive containing 12 frames, each with 435 x 300 mm. The use of drone comb can be combined with phenothiazine treatment, but not with thymol or heat treatment, as this causes bees to build worker comb. Drone combs may be used repeatedly providing the mites have been killed by immersing the combs in water at 55°C for 3 h. The combs are taken out, and with the cappings pierced, are returned to the hive. The bees eat the drone larvae and throw out the dead mites.

PETROV, S.G.; KHAZBIEVICH, L.M. (1980) [A biological trap as a method for controlling Varroa infestations of honeybees.] Doklady TSKhA No. 266 : 139-141 [Ru, B, AA965/85]

In a colony, after earlier replacement of the queen, the first comb of sealed brood appeared in July. Of 148 cells examined, 46% contained mites, whereas on neighbouring combs only 4% of cells contained mites. The first comb was removed to an incubator and 74% of the bees which emerged bore mites. The colony from which the comb had been removed subsequently developed well, and overwintered satisfactorily.

PFEFFERLE, K. (1981) Application of the rotation principle in beekeeping and use of appropriate technical means for obtaining young, healthy colonies free of Varroa disease. Pages 347-354 from "Proceedings of the XXVIIIth International Congress of Apiculture, Acapulco, 1981", Bucharest, Romania : Apimondia Publishing House [En, B, AA616/84]; also in Apiacta 17(2) : 64-70 (1982)

An outline is given of a management system based on the use of new colonies formed from "surplus bees" at the start of the swarming season. Old, weak or queenless colonies are not strengthened and are eliminated if they do not meet requirements. A 3-frame nucleus hive incorporating a funnel, a queen excluder, and a bottom screen with a movable floorboard (used in Varroa control) is described.

PFEFFERLE, K. (1983) Verschiedene Verfahren zur Erzeugung varroafreier Nachwuchskolonien und die laufende Erneuerung des Völkerbestandes durch das Rotationsprinzip. Allgemeine Deutsche Imkerzeitung 17(9) : 281-287 [De, B, AA1346L/85]

POUDOU, J. (1982) Varroase: parasiter le parasite. [Parasitize the parasite.] Revue Francaise d'Apiculture No. 404 : 20 [Fr, B]

Biological control of V. jacobsoni with yeast or other pathogens.

POTJER, A.; ZWART, P. (1984) Varroatose: een zoötechnisch bestrijdinssysteem. [Varroa disease: a zootechnical system of control.] Tijdschrift

3.51 continued

voor Diergeneeskunde 109(2) : 55-57 [Nl, en, B]
A managerial method is described by which the number of varroa mites in a honeybee colony may be reduced to a level consistent with economic beekeeping. This theoretical approach is based on the removal of combs in May, when about 90% of the mites are in the cells with developing larvae and pupae for reproduction.

RADCHENKO, A.K. (1981) [Experiences in the control of Varroa jacobsoni infestations.] Veterinariya, Moscow, USSR No. 4 : 51-52 [Ru, B, AA1332/82]
Treatment against Varroa in spring or autumn was ineffective; summer treatment was also of little benefit if the queen was present, but if infested colonies were kept queenless in the summer and treated with acaricides such as phenothiazine this was a reliable method of control.

RUTTNER, F.; KOENIGER, N. (1980) Eine biologische Methode zur Eliminierung der Varroa-Milben aus Bienenvölkern. [A biological method for the elimination of Varroa mites from bee colonies.] Allgemeine Deutsche Imkerzeitung 14(1) : 11-12 [De, B, AA1010/81]
In a colony infested with V. jacobsoni, if the queen's egg-laying area is restricted, the parasitized brood can be removed. In two series of tests reduction or elimination of mites was achieved by this method.

RUTTNER, F.; KOENIGER, N.; RITTER, W. (1980) Brutstop und Brutentnahme. [Restriction of brood rearing and removal of brood [in the treatment of Varroa infestations].] Allgemeine Deutsche Imkerzeitung 14(5) : 159-160 [De, B, AA1011/81]
The method described by Ruttner and Koeniger (1980) is discussed. A simplified procedure is described for use in the field.

SHILOV, V.N. (1980) [Efficacy of zootechnical methods against varroa disease.] Pchelovodstvo No. 7 : 19-21 [Ru, B, AA1024/81]
Autumn treatment for Varroa infestation is considered unwise, because it weakens colonies just before wintering. For summer treatment four possible methods are suggested: (a) drone comb is periodically cut out; (b) all brood is removed except one comb with young larvae in the middle of the nest - all female mites move onto this comb which is removed when sealed; (c) nuclei without brood are made from young non-flying bees after treating them against the mites; (d) gauze is hung inside the hive above the floorboard when taking control measures so that mites falling from the combs can be caught and removed, thus preventing survivors from re-infesting the colony.
The combined use of methods (a) and (d) resulted in strong colonies ready for the flow or for overwintering; the honey yield was 12-14% higher in these colonies than in a control colony.

VESELÝ, V.; PEROUTKA, M. (1984) Bewertung der Methode zur radikalen Eindämmung der varroatose. Apidologie 15(4) : 379-388 [De, en, fr, B]

ZMARLICKI, C. (1984) Beekeeping with Apis mellifera and mite control in Burma.
The full entry, with annotation, is in 3.24.

3.52 HEAT TREATMENT

BAKSHINOV, A.S. (1980) [Heat treatment of honeybees infested with Varroa jacobsoni mites.] Pchelovodstvo No. 3 : 29-30 [Ru, B]
Includes equipment.

BONDAR, V.M.; KLITSENKO, A.F.; OLIINYK, V.P. (1980) [Thermal chamber with automatic maintenance of temperature (control of Varroa infestation of honeybees (Apis mellifera).] Tvarynnytstvo Ukrainy No. 3 : 48-49 [Uk]

CLÄERR, G. (1984) [Prospettive per i metodi di lotta biologica alla varroasi. [Prospects for a biological control method to control varroa disease.] Pages 78-87 from "Apicoltura sana - agricoltura produttiva, Atti del Convegno Internazionale dell'Apicoltura, Lazise, 29 setembre - 2 ottobre, 1983", Milan, Italy : Studio Edizioni [It, en, B, AA954L/85]
Varroa mites are trapped on a small number of combs of sealed brood which are culled; this is repeated several times.

EVDOKIMENTKO, I.; MAZUR, V. (1979) [Equipment for heat treatment.] Pchelovodstvo No. 1 : 24-25 [Ru, B]
Of Apis mellifera colonies with V. jacobsoni infestation; the chamber is illustrated diagrammatically, and described.

GETTA, V.G. (1982) [Automatic regulator of temperature in heat chamber.] Pchelovodstvo No. 1 : 25 [Ru, B]
For treatment of honeybees infested with V. jacobsoni mites; a circuit diagram is given.

KARPOV, B.; ZABELIN, B. (1978) [Heat treatment for the control of Varroa jacobsoni infestation in bees.] Veterinariya, Moscow, USSR No. 5 : 121-122 [Ru, B, AA581/80]
Treatment should be carried out in autumn when there is little brood, and the ambient temperature is between 0° and 12°C. Combless package bees and swarms may be treated at the time of acquisition. Brood should be destroyed, and young bees 10-15 days old treated. Bees are brushed onto a cassette which consists of a metal frame with holes 4-5 mm in diameter; the bees rest on a net with 2.5 x 3 mm apertures. The cassette is placed horizontally in a heating chamber at 46-48°C for 12-15 min. The temperature must not exceed 48° and care should be taken to keep bees evenly spread on the cassette. The mites fall away. Complete details of the cassette and the heating chamber are given.

KHRUST, I.I. (1978) [Heat treatment for varroa disease.] Pchelovodstvo No. 6 : 5-8 [Ru, B, AA1342/80]
Honeybees infested with the mites are confined in a wire cage and heated for 15 min; at a temperature of 46-48°C the mite loses its grip on the bee's body and may fall off, or can be shaken off. Above 50°C the bees become overheated.

KOMISSAR, A.D. (1979) [Heat treatment of bees.] Pchelovodstvo No. 6 : 17-18 [Ru, B, AA1343/80]
Treatment using the heat chamber is claimed to be up to 100% effective in destroying Varroa mites. Bees are said to survive exposure to a temperature of 46°C for 15-25 min if the density of bees is sufficiently high (1 kg or more in the chamber). Treatment of infested colonies is more effective in autumn than in spring, as the mites are then on the adult bees and not on the brood.

3.52 continued

KOMISSAR, A.D. (1983) [System of relative humidity in thermal treatment.] Pchelovodstvo No. 7 : 15-16 [Ru, B]

KONSTANTINOVIĆ, B.; MLADENOVIĆ, M. (1985) A contribution to the investigation of thermic treatment of bees societies in the fight against *Varroa jacobsoni*. Page 81 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

In USSR special devices have been designed for the thermal treatment of honeybees with *V. jacobsoni*. Bees are treated at a temperature of 46-48°C, for about 15 minutes.

A heating chamber for liquefying honey was used and the method involved

(a) Taking colonies from the apiary (temperature about 0°C) and putting them into the heated chamber.

or (b) Treating winter cluster on frames

or (c) Shaking bees into wire cages, which are put into the chamber.

Colonies in hives were also treated in a building at 25°C for 2 h, and then fumigated with Folbex VA, Apiacaridim and Varamit. The methods were successful when bees were treated in January and early February.

NEKRASOV, V.N. (1981) [Heat treatment not harmful to queens.] Pchelovodstvo No. 3 : 14-15 [Ru, B]

For control of *V. jacobsoni*.

NOVIKOV, V.S.; BARABANOVA, V.V. (1980) [Thermal treatment in combination with acaricide preparations for therapy of honeybees infested with *Varroa* mites.] Sbornik Nauchnykh Rabot, Sibirskii Nauchno-Issledovatel'skii Veterinarnyi Institut No. 38 : 160-161 [Ru, AA586L/85]

SOLOV'EVA, L.F. (1983) [Thermal treatment to control varroa disease of honeybees.] Pchelovodstvo No. 1 : 17-18 [Ru, B, AA947/84]

Various thermal and other treatments were compared using groups of 20 colonies. Thermal treatment in spring was more effective than treatment with phenothiazine or Sineakar, and it did not retard growth of colonies so much, but to repeat the treatment in a single-space heat chamber after an interval of only a month could retard and even kill a colony. The best results were obtained in autumn with a multi-space heat chamber.

VETLOVA, I.V. (1980) [Comparative study of the effects of heat treatment and some acaricides in the treatment of honeybees infested by *Varroa jacobsoni*.] Sbornik Nauchnykh Trudov Moskovskaya Veterinarnaya Akademiya 116 : 84-87 [Ru, B, AA1273/83]

Tests were made of the effectiveness of a number of chemicals including 'TM', Folbex, menthol, ether sulphonate, naphthalene, sulphur and 'Sineacar', and also of the effects of temperature (37, 38 and 48°C). Tests were made in cages on honeybees infested with *Varroa*. At least 10 cages were used for each treatment with a queen and small retinue of workers in each. Counts of dead mites and of dead bees at stated times gave a measure of the effects of the treatments. 'TM' killed 100% of the mites in 10 mins, and no bees in this time. Folbex took nearly 20 mins to kill 100% of the mites, by which time 50% of the bees had died. Menthol, sulphur and 'Sineacar' and the temperatures 37 and 38° took 1-2 days to kill most of the mites, and less than 20% of the bees. The other chemicals and a temperature of 48° were too lethal to bees to be useful.

3.53 OTHER PHYSICAL TREATMENTS

OZEROV, A.P. (1979) [Fan-type mite-trapping bracket.] Pchelovodstvo No. 2 : 20 [Ru, B]

For control of V. jacobsoni and acarine mites, and ventilation of beehive.

SCHLEY, P. (1979) Zur Anwendung von Gammastrahlen bei varroatoseverseuchten Bienenvölkern. [The use of gamma-rays on honeybee colonies infested with Varroa.] Biene 115(10) : 418-420 [De, B, AA1344L/80]

SYCHEV, M.M.; BUT, A.I.; KONDRAKOV, M.K. (1981) [Effects of some physical factors on honeybees and on [Varroa jacobsoni] mites.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noi Veterinarii 41 : 60-62 [Ru, B, AA567/85]

No physical factors were found which were more effective against V. jacobsoni than they were harmful to bees. Ozone (produced by a high voltage discharge) at a concentration of 1-2 g/m^3 weakened and sometimes killed bees without any apparent effect on Varroa.

3.54 BACTERIAL TREATMENT

MIKITYUK, V.V.; KORZHOVA, L.N. (1981) [The use of bacterial insecticides/-acaricides against varroa disease.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noi Veterinarii 41 : 76-78 [Ru, B, AA573L/85]

A strain of Bacillus thuringiensis, in doses of 0.35 µg, was toxic to Varroa but practically harmless to bees.

3.6 CHEMICAL METHODS OF CONTROL

The entries in this section are numbered (v1, v2, ...), and are indexed under chemical and trade names in Section 5. Publications relating to the most commonly tested agents are entered first, under a familiar name (3.61-3.68), and then reports on other agents and general papers in a single sequence (3.69).

3.61 AMITRAZ (FUMILAT A, TAKTIC, TCL, VARRESCENS)

v1 COLIN, M.E.; FAUCON, J.P.; MORAND, M. (1983) Utilisation of aerosol to treat bee-colonies against varroatosis (Varroase). Pages 71-72 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1276L/84]

Preliminary report of an aerosol heated to more than 30°C, containing amitraz and a mite repellent, e.g. 0.5% menthol.

v2 CSABA, G.; KÁVAI, A. (1984) Varrescens fumigating strip for the control of varroa disease. Apiacta 19(2) : 34-36 [En, B, AA968/85]

This fumigating strip (produced by Hungaronektár, Budapest) is impregnated with a low concentration of amitraz; it takes about 90 s to burn. About 10 000 colonies have been treated with the Varrescens strip, and no queen losses or other adverse effects on the colonies have been reported. Treatment of an infested colony in summer kills 85-90% of mites within 1 h, and the rest in 16 h; in autumn, mites take up to 24 h to die. No amitraz was found in honey harvested from treated colonies. In comparative tests, Varrescens was more effective than Folbex-VA or Varroatin. For best results, repeated treatment with Varrescens in September and October is recommended.

v3 DARGHOUTH, M.A.; KILANI, M. (1984) Essai de l'utilisation de l'amitraz pour le traitement des ruches atteintes de varroase. [Test of the use of amitraz for the treatment of hives with varroa disease.] Maghreb Vétérinaire 1(5) : 9-13 [Fr, en, ar, B]

Amitraz sprayed at 50 ppm on to hive frames was effective for treating varroa disease; 91.4-95% of mites were killed and the bees were not harmed.

v4 KILANI, M.; BUSSIERAS, J.; POPA, A.; SAKLI, A. (1981) Essai préliminaire de traitement de la varroase (à Varroa jacobsoni) de l'abeille domestique par l'amitraz. [A preliminary trial on the treatment of varroa disease with amitraz.] Apidologie 12(1) : 31-36 [Fr, en, de, B, AA252/82]

This acaricide is of the diamidide type. Groups of 160 bees from infested colonies were treated with an aqueous suspension of amitraz at concentrations from 0.001 to 0.1%; some groups were sprayed with 10 ml suspension, and in other groups it was allowed to disperse through the hive by evaporation.

Good results were obtained at a concentration of 0.001%, which killed 96.5% of varroa mites and only 1.64% of the bees by the evaporation method, and 100% and 5.2% respectively by spraying. Bee mortality was higher when the amitraz concentration was increased.

3.61 continued

v5 MARCHETTI, S.; BARBATTINI, R. (1984) Comparative effectiveness of treatments used to control Varroa jacobsoni Oud. Apidologie 15(4) : 363-378 [En, de, fr, B]

v6 PEROUTKA, M.; VESELÝ, V. (1984) The use of amitraz in Taktic - a preparation for the diagnosis and treatment of varroa disease in bees. Apiacta 19(2) : 40 [En, B, AA970/85]

Taktic, which contains 12.5% amitraz, was used as an aqueous emulsion spray at a concentration of 0.01% (by vol). In colonies treated in July, the infestation level decreased by 94% from 4.48 female mites/100 bees to 0.26 mites/100 bees. In colonies with sealed brood, mite mortality varied from 64.3% to 88.8%. In colonies treated in October almost all mites were killed. For diagnosis of varroa disease, Taktic is applied at the same rate, and hive debris is examined 12-16 h later. In an examination of debris from 651 colonies treated with Taktic in November-December, Varroa was present in 49 colonies. In 3 colonies Varroa was diagnosed using a washing method, although Taktic had not revealed the presence of the mites. The results indicate that the use of Taktic for diagnostic purposes is 94% successful.

v7 ROMANIUK, K.; LIPINSKI, Z. (1981) Próby zwalczania inwazji Varroa jacobsoni (Oudemans 1904) u pszczól przy pomocy preparatu TCL. [Trials of a TCL preparation for the control of Varroa jacobsoni on honeybees.] Medycyna Weterynaryjna 37(6) : 342-344 [Pl, en, ru, B, AA257/82]

An aqueous solution (200-250 ml) containing 0.00012% TCL was sprayed onto bees and brood in 130 Varroa-infested colonies; many of the mites were killed, and in 2 colonies no mites were found after treatment. Average mite mortality was 93%. TCL displayed no toxic effects on bees or brood during the 7 days after spraying.

v8 ROMANIUK, K.; LIPINSKI, Z. (1982) Terenowa przydatność preparatu TCL (amitraza) do zwalczania warrozy u pszczoly miodnej. [Effectiveness of TCL (amitraz) for the control of varroa disease in honeybees.] Medycyna Weterynaryjna 38(8/9) : 450-453 [Pl, en, ru, B, AA1291/83]

Samples of bees were examined for V. jacobsoni before treatment with amitraz, and again 6 days later. Amitraz was applied in 0.0001% aqueous solution at a dose of 250 ml/colony. No harmful effects on brood or workers or on queen oviposition were observed, but mites were seen to fall from their hosts. Six days after a single spray the number of infested bees was 89% less than before treatment, but effectiveness was increased to 92-100% if 2 applications of amitraz were made.

v9 ROMANIUK, K. (1983) Fumilat A-skuteczny i łatwy w użyciu lek do zwalczania warrozy pszczół. [Fumilat-A for the control of Varroa.] Medycyna Weterynaryjna 39(6) : 340-343 [Pl, en, ru, B, AA246/85]

Fumilat A is a fumigant strip containing amitraz. In colonies with honeybee brood, mortality of V. jacobsoni reached a maximum (93.5%) 3 h after treatment; in colonies without brood, mite mortality was 100% after 6 days. No harmful effects on adult bees or bee brood were observed.

3.62 CHLORDIMEFORM (CHLORPHENAMIDINE, FUNDAL, GALECRON); CHLORDIMEFORM HYDROCHLORIDE (K-79)

v10 ALPATOV, V.V.; LANGE, A.B.; TATSIĬ, V.M.; NATSKIĬ, K.B. (1977) [The selection and development of substances for use against *Varroa*.] Pages 61-66 from "*Varroa* infestation of honeybees" ed. V.V. Alpatov and 6 others, Moscow, USSR : Izdatel'stvo Nauka [Ru, E1555, B, AA1047/79]

Tests of 3 Japanese acaricidal smoke preparations, Varostan (A), Galecron (B) and Danikoroba (C), were made in 14 honeybee colonies in which the numbers of female *Varroa* were known. The number of female *Varroa* destroyed were: A, 3-50%; B, 6%; C, 4-18%; controls, 1-2%. The wide variation in the results was thought to be due to the different degrees of brood development in the colonies.

It was noted that the number of mites on capped drone brood was 20 times as high as the number on capped worker brood, and it is suggested that patches of drone brood should be squashed with a hive tool. Other possible methods for controlling the disease and for testing acaracides are discussed.

v11 CRANE, E. (1984) Living with *Varroa* in Japan. Bee World 65(4) : 149-150 [En, B, AA956L/85]

Describes the use of amitraz, chlordimeform, chlorobenzilate, Tedion or tetradifon (sold as Danikoropa) and phenothiazine.

v12 HARLANDER, B. (1981) Feldversuch mit K-79 zur Bekämpfung der Varroatose im November/Dezember 1980 in Hessen. [Field trials with K-79 for the treatment of varroa disease in November/December 1980 in Hessen.] Allgemeine Deutsche Imkerzeitung 15(7) : 202-204 [De, B, AA585L/82]

v13 HARLANDER, B.; RUTTNER, F. (1983) Bekämpfung der varroatose; systemisch wirkende Substanzen, integrierter Bienenschutz. [Control of varroa disease; systemic substances, integrated bee protection.] Mitteilungen der Deutschen Gesellschaft für Allgemeine und Angewandte Entomologie 4(1/3) : 26-28 [De, en]

v14 MORITZ, R.F.A. (1982) Präparatverteilung bei systemischer Therapie von Ektoparasitosen bei *Apis mellifera* L. [Drug distribution in systemic therapy of ectoparasitoses of *Apis mellifera*.] Apidologie 13(2) : 127-141 [De, en, fr, B, AA615/83]

K-79 (chlordimeform hydrochloride) has been shown to kill varroa mites; for effective treatment, a good distribution of the chemical throughout the affected colony is necessary. In a study of the distribution using (A) a radioactive tracer, and (B) methylene blue dye, it was found that Apirêve 80 S (a commercial sugar solution) was a suitable carrier for K-79. After identical applications (2 x 50 ml Apirêve with 0.07% K-79) the mean intake of K-79 was 5.4 and 10.2 µl per worker honeybee, in summer and winter, respectively.

Two treatments of 50 ml Apirêve containing 0.07% K-79 were more effective than single treatments of 50, 100 or 200 ml. In summer, the highest mite mortality was 94.5% and in winter 98.02%. A further disadvantage of summer treatment was that K-79 was found in about 75% of honey cells.

v15 RUTTNER, F. (1980) Versuche mit neuen Verfahren zur Behandlung der Varroatose. [Testing of new methods for the treatment of varroa disease.] Biene 116(5) : 198-201 [De, B, AA1038/81]

In preliminary laboratory and field tests *Varroa*-infected bees were given food containing the acaricide K-79. Winter treatment of a brood-free colony gave best results, 99% of mites being killed. The acaricide acted systemically through the bees' haemolymph.

3.62 continued

v16 **RUTTNER, F.; RITTER, W.; GÖTZ, W. (1980) Chemotherapie der Varroatose über die Haemolymphe der Biene.** [Chemotherapeutic measures for controlling Varroa jacobsoni via the haemolymph of the honeybee.] Allgemeine Deutsche Imkerzeitung 14(5) : 160-165 [De, E1569, B, AA1039/81]

Preliminary results using K-79 were reported in the previous abstract. In further laboratory and field trials the colony was either fed with 35 mg K-79 in 50 ml water, or the solution was sprinkled onto the bees, which then licked it. In wintering colonies the solution was sprinkled onto bees at the top of the cluster. The chemical was absorbed into the bees' haemolymph and was thus ingested by mites feeding on the bees. The chemical was not harmful to the colony, but it killed almost 100% of the mites feeding on adult bees. However, concentrations of K-79 in larval haemolymph were not sufficient to kill mites feeding on brood. Analysis of honey samples from treated colonies showed levels of K-79 at or below the detectable limit of 0.01 ppm.

v17 **SMIRNOV, A.M.; CHERNOV, K.S. (1976) [Beekeeping in Japan.]** Pchelovodstvo No. 2; 3; 4; 5 : 27-28; 29-30; 36-38; 45-47 [Ru, B, AA944/78]

This series includes a section on enemies and diseases of honeybees, and, in particular, V. jacobsoni. This mite was first found in Japan in 1955, had spread to most of the south by 1958, and was in all areas within 10 years. The usual treatment then was to burn infected stocks and sterilize hives with caustic soda. Nowadays hives are fumigated from above with preparations containing phenothiazine, tetradifon or Folbex; bees, including the queen, sometimes die, and it is not known how honey is affected. There are reports of mites that have developed resistance to these chemicals, so new preparations (chlordimeform, Varostan, Danikoroba, Danikan, Perion) are being tried.

v18 **SOTNIKOV, A.N. (1981) [Acaricidal effects and toxicity to honeybees of some preparations used against varroa disease.]** Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 68-69 [Ru, B, AA566/85]

In laboratory tests, nilverm, dertil and benacil (anthelminthics) given in sugar syrup in doses of 200 µg/bee were toxic to bees and harmless to Varroa. The insecticide/acaricide Galecron (chlordimeform) in doses of 0.5-5 µg was not toxic to bees and caused 100% mortality of Varroa in 144 h; it is therefore recommended for field trials in apiaries.

v19 **WACHENDÖRFER, G. (AND 8 OTHERS) (1981) Erfahrungen mit dem Akarizid K79 (Chlordimeformhydrochlorid) in Hessen zur Bekämpfung der Varroatose der Honigbiene.** [Results with the acaricide K79 (chlordimeform hydrochloride) used in Hessen against varroa disease of the honeybee.] Deutsche Tierärztliche Wochenschrift 88(5) : 161-168 [De, en, B, AA935/82]

Following preliminary reports, results are now given for tests using K79 on 14 000 brood-free colonies (in November/December) in 1400 apiaries in Hessen; 66% of the colonies were infested by Varroa. Each colony received 2 applications, each of 35 mg K79, at an interval of 7-10 days; there were apparently no harmful effects on the bees. After treatment, 73 previously infested colonies were destroyed for examination; about half contained no mites. In the remaining colonies about 95% of mites had been killed.

3.63 DICOFOL (KELTHANE)

v20 KHAZBIEVICH, L.M. (1977) [A "sanpropusknik" [cage for treating bees] in an apiary infested with Varroa.] Pages 93-95 from "Varroa infestation of honeybees" ed. V.V. Alpatov and 6 others, Moscow, USSR : Izdatel'stvo Nauka [Ru, B, AA1048/79]

This device consists of a container, 450 x 400 x 350 mm, with a steel mesh base with 4 x 4 mm apertures under which there is a movable plastic tray. A thermostatically controlled electric heater keeps the temperature of the container at not less than 15°C. Bees from an infested colony are shaken into the container where they are exposed to a chemical which causes the mites to drop off and fall into the tray. Suitable fast-acting chemicals are naphthalene, Tedion, Folbex, Kelthane, or phenothiazine.

v21 LAERE, O. VAN; IFANTIDIS, M. (1983) Smoke production and treatment of honeybees with dicofol for control of Varroa jacobsoni. Pages 57-61 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1274/84]

Strips containing 0.5 g dicofol were burnt in a special device. In laboratory tests the 24-h LD$_{50}$ for V. jacobsoni was reached with 5 mg dicofol/dm^3 for 9 min. Using 10 mg/dm^3, all treatments for 4 min or longer gave 100% mortality after 24 h. The effects on honeybee mortality were insignificant.

v22 LAERE, O. VAN; IFANTIDIS, M.; WAEL, L. DE (1983) Dicofol-Rauchern von Honigbienen zur Bekämpfung der Milbe Varroa jacobsoni. [Dicofol fumigation of honeybees for the control of Varroa jacobsoni.] Apidologie 14(3) : 175-182 [De, en, fr, B, AA563/85]

Paper wicks were each impregnated with 0.5 g of dicofol plus a small quantity of potassium nitrate. Small groups of Varroa-infested bees in cages were fumigated; treatment with 5 mg dicofol/dm^3 killed 50% of Varroa in c. 9 min. With 10 mg/dm^3, all mites were killed in 4 min. At this dose, fumigation times of 2, 4, 8, 16 and 32 min appeared harmless to bees. The mites' reaction to the smoke was to leave the bees, thus exposing themselves to a greater concentration of smoke.

v23 MAUL, V.; PETERSEN, N.; WISSEN, W. (1980) Feldversuche zur klinischen Erprobung von Kelthane und Brompropylat. [Field trials for the clinical testing of Kelthane and bromopropylate [against Varroa jacobsoni].] Allgemeine Deutsche Imkerzeitung 14(5) : 149-150 [De, B, AA1031/81]

A 1.5% aqueous suspension of Kelthane was sprayed into the bee space of 56 heavily infested colonies at the end of July. The number of dead mites collected ranged from 0 to 517. After treatment of 35 weakly infested colonies in September with a 0.6% aqueous suspension of bromopropylate, from 0 to 19 dead mites were collected. The average effectiveness of these acaricides was 40-50%; the widely varying results are attributed to the method of application.

v24 POLTEV, V.I.; LIKHOTIN, A.K. (1975) [Diagnosis and treatment of Varroa disease in honeybees.] Veterinariya, Moscow, USSR No. 11 : 60-61 [Ru, AA576/78]

Generation of smoke containing Kelthane, Folbex or phenothiazine, controlled V. jacobsoni in hives and was not toxic to the bees.

3.63 continued

v25 RITTER, W.; RUTTNER, F. (1980) Chemotherapie. [Chemotherapy [of *Varroa jacobsoni* infestations].] Allgemeine Deutsche Imkerzeitung 14(5) : 138-146 [De, B, AA1029/81]

The toxicity of over 60 chemicals was tested in the laboratory, first on bees and then, within the range not toxic to bees, on *Varroa*. The best were subjected to field tests. The most effective chemical was Kelthane. Varostan killed mites effectively but also 20% of bees; bromopropylate seemed promising and with improved formulations bee losses might be reduced. Mustard oil was effective in high or low concentrations, and 10% ethyl formate killed 80% of mites. Carbolineum killed over 90% of mites, and heat treatment of bees at 49°C killed 85% of mites.

v26 RITTER, W. (1980) Zur Methodik der Prüfung von Chemotherapeutika zur Bekämpfung der Varroatose der Honigbiene. [A method for testing chemotherapeutical substances used in controlling varroa disease.] Apidologie 11(2) : 131-141 [De, en, fr, B, AA1411/81]

The methods summarized by Ritter and Ruttner (1980) are described more fully. For an approximate estimate of mites remaining in a colony after chemical treatment, the removal and killing of one frame of bees is sufficient. By shaking with benzine, over 99% of mites are washed off; other liquids (e.g. pentane, water plus detergent) are less efficient.

v27 RITTER, W. (1980) Versuche mit Kelthane am Institut Oberursel. [Tests with Kelthane [against *Varroa jacobsoni*] at the Oberursel Institute.] Allgemeine Deutsche Imkerzeitung 14(5) : 146-149 [De, B, AA1030/81]

After laboratory testing, the acaricide Kelthane was subjected to field tests in over 4000 colonies. The standard method of application was to spray the bees in a colony with 200 ml of a 1.5% suspension of Kelthane in water. Although this was the most effective of all chemicals tested, results were variable, and in colonies without brood it was only 55-65% effective. Combinations of Kelthane with other products were no better. Honey from 7 colonies treated 3 times with Kelthane (during the flow) was analysed; the samples contained from 0.2 to 0.7 ppm of Kelthane.

3.64 FOLBEX (CHLOROBENZILATE, AKAR-338)

v28 ARTEMENKO, L.P.; SKRYPNIK, E.I.; SABADIN, B.M.; ZAICHIKOVA, V.A. (1978) [Akar-338 for varroa disease.] Pchelovodstvo No. 7 : 20-21 [Ru, B, AA983/80]

The 5 acaricides tested in the laboratory were Rospin, melbex, gelekron [Galecron?], Neoron and Akar-338, in aerosol, fumigant or powder form. Akar-338 was very effective against *Varroa*.

v29 LAIGO, F.M.; MORSE, R.A. (1969) Control of the bee mites, *Varroa jacobsoni* Oudemans and *Tropilaelaps clareae* Delfinado and Baker with chlorobenzilate. Philippine Entomologist 1(2) : 144-148 [En, B, AA434/71]

Brood nests of *Apis mellifera* infested with *V. jacobsoni* were treated with one of two formulations of chlorobenzilate. Single treatments with a local chlorobenzilate formulation or Folbex strip yielded 18 and 24 mites per colony respectively. Further treatment after 2 months yielded 48 and 40 mites respectively. Weekly treatment for 12 weeks with Folbex caused a significant reduction in the mite population in the 4th week; further treatment reduced the population further but did not eradicate the mites. Results are not given for *Tropilaelaps clareae* because the incidence of infestation was low.

3.64 continued

It is recommended that colonies should be treated 3 times at weekly intervals, and that each series of treatments should be repeated every 2-3 months.

v30 RENNINGHOFF, V.; RITTER, W. (1980) Erfahrungen mit der Varroatose-Therapie in Tunesien. [Results with the treatment of varroa disease in Tunisia.] Allgemeine Deutsche Imkerzeitung 14(5) : 150-151 [De, B, AA1032/81]

Varroa was first identified in Tunisia in 1978, though it may have been present before that. Laboratory and field tests gave unsatisfactory results for formic acid; but phenothiazine killed over 70% of mites, and Folbex over 90%. Bromopropylate gave the best results (over 96% mite mortality) in colonies with and without brood. Bee mortality in the laboratory tests was not high except for high concentrations of Folbex (38%) and formic acid (20%).

v31 SELIVANOVA, A.S.; GROBOV, O.F.; SEDOV, V.A.; CHIGAREVA, O.I.; ANTONOVA, I.A. (1982) [Treatments for controlling *Varroa* infestations of honeybees.] Veterinariya, Moscow, USSR No. 8 : 55-58 [Ru, B, AA1280/84]

The following treatments are described. (1) Phenothiazine applied as a smoke from a burning tablet or strip. This is blown from a smoker into the entrance of the hive which is then closed for 15-20 min. Treatments may be carried out in spring and autumn when the temperature is not below 15°C, and are said to be 40-96% effective according to how airtight the hive is. (2) Thymol applied in doses of 10-15 g per hive in spring and autumn, is harmless to bees and 97% effective against *Varroa*. It may be sprinkled on the top bars of the brood chamber. (3) Naphthalene is effective against *Varroa* but kills bee brood, therefore 2-3 g may be applied in autumn when there is no brood present. A special 'incandescence chamber' is used to apply it as a smoke. (4) Varroatin (dicresyl ether methyl carbaminic acid) is applied as an aerosol in the summer, but care must be taken as the dosage is critical and too much will kill the bees. (5) Formic acid can be used in hives as bees can survive a concentration 80 times as high as that which is lethal to *Varroa*, but it must be used with care. (6) Folbex may be used if the hive is without brood. The strips are incinerated and the hive is hermetically sealed for 25-30 min. The treatment is 50% effective in spring, 90% in the autumn, and 98% in broodless nuclei.

v32 SHABLIĬ, M. YA. (1981) [Studies on the effects of various acaricides on *Varroa jacobsoni*.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 70-71 [Ru, B, AA568L/85]

The most effective of the preparations tested were Akar-338 and thymol.

v33 SKRYPNIK, E.I.; ARTEMENKO, L.P.; MIKITYUK, V.V.; SHABLIĬ, M. YA.; ABAKUMOV, A.M. (1979) [Akar-338 in various climatic zones.] Pchelovodstvo No. 9 : 19-21 [Ru, B, AA985L/80]

Swiss preparation (for killing mites on plants) tested for use on mites parasitizing honeybees.

v34 TITOV, V.F.; VAS'KOV, N.A.; STOLBOV, N.M.; GROBOV, O.F.; POPOV, E.T. (1984) [Folbex for *Varroa* infestations.] Veterinariya, Moscow, USSR No. 5 : 46-47 [Ru, B, AA964/85

3.64 continued

The use of smouldering strips of Folbex for the fumigation of colonies is described. The hive should be hermetically sealed for 25-30 min and provided the air temperature is not below 12°C the treatment may be performed in summer or autumn and repeated once after 24 h. The procedure is said to be 97% effective in killing Varroa. In autumn there is some danger that the queen may be killed; this can be avoided by feeding with sugar syrup, or by temporarily caging the queen.

v35 VAS'KOV, N.A.; TITOV, V.F.; DAUROVA, E.G.; TIKHOMIROV, S.M. (1979) [Chlorobenzilate for treating varroa disease.] Pchelovodstvo No. 12 : 19 [Ru, B, AA1022L/81]

Folbex was 97-98% effective in killing V. jacobsoni; it is recommended for use in honeybee colonies in spring before brood rearing begins.

3.65 FOLBEX-VA (FOLBEX-VA-NEU, FOLBEX-FORTE, ISOPROPYL-4,4'-DIBROMOBENZILATE, BROMOPROPYLATE, NEORON, VARROATEX)

v36 ABEILLE DE FRANCE ET L'APICULTEUR (1984) Face à la varroase (méthode utilisée avec succès en Chine). [Coping with varroa disease (method used with success in China).] Abeille de France et l'Apiculteur No. 682 : 179 [Fr, B, AA570L/85]

Using artificial swarming and treatment with Folbex-VA or another acaricide.

v37 KLEPSCH, A.; MAUL, V.; PETERSEN, N.; KOENIGER, N.; GÖTZ, W. (1983) Feldversuch zur Varroatosebekämpfung mit Folbex VA Neu. [Field test of the treatment of varroa disease with Folbex VA Neu.] Biene 119(2) : 54-57 [De, B, AA943/84]

In these trials, in which a total of 320 colonies were treated, adverse effects on the bees were minimal. In 34 of the colonies the percentage of mites killed by each of 4 applications was assessed and the number of surviving mites counted. The mean total kill after 4 applications was 82%.

v38 MALININ, O.A.; YAROSHENKO, V.I.; ALEKSEENKO, F.M. (1981) [Determination of neoron in honey.] Veterinariya, Moscow, USSR No. 9 : 68-69 [Ru, B, AA274/83]

Neoron is described as a mildly toxic substance used as a treatment against Varroa infestations. The oral LD_{50} in rats is 5000 mg/kg. In the concentrations used against Varroa (0.5 g per hive) it is harmless to bees.

A method of detecting residues in honey using gas chromatography is described. After 2-3 applications to hives, residues in honey stored for 6-7 months were 0.028-0.035 mg/kg. With 3-8 applications the quantity found in extracted (centrifuged) and comb honey varied from 0.07 to 0.52 mg/kg. No harmful effects to bees were observed.

After storing for 6 months the content of neoron in honey decreased by 30-60%. This was independent of temperature.

v39 MIMA, T. (1985) Effect of bromopropylate on Varroa mites and its safety to bees. Pages 76-77 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

3.65 continued

In field trials, infested colonies were treated with 1, 2 or 3 smouldering strips each containing 370 mg iso-propyl-4,4'-dibromobenzilate (bromopropylate, Folbex VA, Varroatex). Four treatments with one strip at intervals of 4 days were adequate for effective control of Varroa mites. Bee mortality was not significantly higher than in control colonies.

v40 MLADAN, V.; ERSKI-BILJIĆ, M.; JAKIC, D.; SIMIĆ, M. (1985) Primena nekih preparata u suzbijanju varooze-I. [The use of some preparations to the eradication of varroa disease. I.] Veterinarski Glasnik 39(4/5) : 489-496 [Sh, en, ru, B]

The efficacy of 6 chemical agents (Folbex VA, thymol, Apiakaridim, Varinikol, Varitan and phenothiazine) was tested on the mite, and their effect on adult queens and workers, and on larvae was assessed. None of the agents killed all V. jacobsoni; thymol was the most effective, and good results were also obtained with Folbex VA and with Apiakaridim. No harmful effects on bees were observed.

v41 RADEMACHER, E.; BÖTTCHER, H. (1984) Die Behandlung von Naturschwärmen gegen Varroatose mit dem Präparat "Folbex VA Neu". [The treatment of feral swarms against varroa disease using Folbex-VA.] Allgemeine Deutsche Imkerzeitung 18(6) : 194-198 [De, B, AA/86]

v42 RENNINGHOFF, V.; RITTER, W. (1983) Feldversuche zur Bekämpfung der Bienenmilbe Varroa jacobsoni mit Folbex-VA-NEU und biotechnische Massnahmen auf einer Bienenfarm in Tunesien. [Field trials on the control of Varroa jacobsoni with Folbex-VA-Neu and biotechnical methods at a bee-farm in Tunisia.] Berliner und Münchener Tierärztliche Wochenschrift 96 : 239-241 [De, fr, B, AA1336/85]

V. jacobsoni was first reported in Tunisia in July 1978; at the end of 1980, in an apiary 60 km from Tunis, 600 of the 1200 colonies were found to be infested. Folbex-VA-Neu was used for treatment, with 4 daily applications. Three methods of application were tested on groups of 10 brood-free colonies. The best method, which killed over 96% mites on average, was to burn 1 Folbex strip in a special apparatus put inside the hive.

v43 RITTER, W. (1982) Möglichkeiten der Behandlung von Bienenvolkern gegen die Varroatose und Milbenseuche. [Possible methods for treating honeybee colonies against Varroa and acarine disease.] Pages 70-83 from "Tagung der Fachgruppe Tierseuchenrecht. Giessen, 18-19 Marz, 1982", Giessen, German Federal Republic : Deutsche Veterinärmedizinische Gesellschaft e.v. [De, B, AA600/83]

Folbex-VA-Neu is applied as a smoke to kill parasitic mites. It was used on a total of 2600 honeybee colonies without harming adult bees or brood. For treatment of acarine disease, a colony should be smoked with the substance 6 times within 7 days in early spring. Colonies infested with Varroa are best treated by 4 applications on consecutive days in autumn.

v44 RITTER, W.; PERSCHIL, F.; CZARNECKI, J.M. (1983) Treatment of bee colonies with isopropyl-4,4-dibromo-benzilate against varroa disease and acarine disease. Zentralblatt für Veterinärmedizin, B 30 : 266-273 [En, de, es, fr, B, AA280/84]

3.65 continued

In the Berlin area, hived swarms were treated twice in 24 h. Results are given for the effectiveness of the treatment and the levels of infestation found.

In field trials, fumigant strips containing isopropyl-4,4-dibromobenzilate (Folbex-VA) were burned in test hives (total 2600 hives) in the evening when foragers had returned. Bee mortality (workers and queens), behaviour and brood rearing were normal. A. woodi infestations were eliminated completely in spring by 6 applications of one fumigant strip per colony at intervals of 7 days. V. jacobsoni infestations were reduced by 97% in autumn with 4 applications of one strip per colony at intervals of 4 days. In laboratory tests Folbex-VA was significantly more toxic to V. jacobsoni, but less toxic to A. woodi, than chlorobenzilate (Folbex); it was also much less toxic to honeybees. It is recommended that Folbex-VA should be burned in an empty upper chamber (provided to allow the bees more space during the treatment). Food should be available e.g. uncapped honey or syrup, and the external temperature should be above freezing, but below 10°C.

v45 **RITTER, W.; PERSCHIL, F. (1983) Prüfung der Wirkung von Folbex-VA (isopropyl-4,4'-dibrombenzilat) auf Varroamilben und der Verträglichkeit für Bienen.** [Effects of Folbex-VA (isopropyl-4,4'-dibromobenzilate) on Varroa mites, and its tolerance by honeybees.] Apidologie 14(1) : 9-27 [De, en, fr, B, AA929/84]

Two applications of Folbex-VA fumigant strips (with an interval of 4 days) were sufficient to detect V. jacobsoni infestations of more than 5 mites/colony. In spring, in colonies with sealed brood, 4 applications of the fumigant strip killed 59% of the mites present; in autumn, 75% of mites were killed in colonies with brood, and 97% in colonies without brood.

Artificial swarms were successfully treated (98% of mites killed) with 2 applications 24 h apart. No adverse effects on adult bees or on brood were observed in any of the tests.

v46 **RITTER, W.; DELAÎTRE, N.; IFANTIDIS, M. (1984) Use of Folbex-VA in smoker to control varroa disease.** Apiacta 19(2) : 37-39 [En, B, AA969/85]

By burning several Folbex-VA strips in a smoker, several colonies can be treated in turn. The aperture of the smoker is lengthened so that it can be pushed through a slit in the plastic with which the hive entrance is closed. The strips burn for about 8 min, whatever the number of strips. The most satisfactory procedure is to burn 8 strips together in the smoker, treating 8 colonies by giving each 8 puffs of smoke at 5-s intervals. This was almost as effective as burning a single strip inside the hive.

v47 **SANTAS, L.A. (1985) Winter treatment with Folbex-VA against varroa disease in Greece.** Pages 264-268 from "Proceedings of the XXIXth International Congress of Apiculture, Budapest, 1983." Bucharest, Romania : Apimondia Publishing House [En, B, AA264/86]

Trials of Folbex-VA were carried out in November-December 1981 using 10 infested colonies from which all sealed brood has been removed. Six treatments, with one fumigant strip/hive, were applied at 6-day intervals; 3 other infested colonies were left untreated as controls. The treatments were repeated in December 1982, using 4 applications at 4-day intervals. The high infestations in colonies in 1981 were reduced by 95-100%, and the light infestations in the same colonies one year later were

3.65 continued

reduced by the same amount. Infestations in control colonies were 2-5 times as high in December 1982 as in December 1981. There were no adverse effects on bees or brood, and queens began to lay eggs in late December; 2 colonies swarmed in spring 1982.

v48 STORT, A.C.; BUENO DE MORAES, M.M.; GONÇALVES, L.S. (1985) Study on Folbex-VA effectiveness in controlling Varroa jacobsoni. Pages 77 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Africanized colonies were treated with fumigant strips, each containing 370 mg of bromopropylate; there were 4 treatments at intervals of 4 days. Before treatment, the mean number of mites was 38 per 500 workers from each colony and afterwards it was 3.8.

v49 TAKEUCHI, K.; SAKAI, T. (1985) A possible combination of three different control measures for Varroasis. Pages 74-75 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

The methods are: (a) fumigation with Folbex-VA at 4-day intervals, (b) evaporation of amitraz at the bottom of the hive, (c) spraying an aqueous solution of oxalic acid directly on to frames with bees (approx. 300 mg oxalic acid/frame). The methods could be combined in an annual control programme.

v50 TEMIZ, A.I. (1983) Folbex-VA ilacinin Varroa parazitine karsi etkinliğinin saptanmasi üzerine arastirmalar. [Effectiveness of Folbex-VA against the parasite Varroa [jacobsoni] in comparison with other preparations.] Ege Bölge Zirai Araştirma Enstitüsü Yayinlari No. 35 : iv + 36 pp. [Tr, en, B, AA1283/84]

In comparative tests, Folbex-VA was found to be more effective in reducing Varroa infestations than naphthalene, GLO (paradichlorobenzene), formic acid, tobacco smoke, smoke of pine needles, and a formulation of malathion dust. Honeybee mortality was slightly increased by the formic acid treatment, but none of the treatments affected brood mortality.

3.66 FORMIC ACID

v51 HARAGSIM, O. (1982) Liečenie varroatóznych včelstiev kyselinou mravčou. [Use of formic acid to treat honeybee colonies with Varroa jacobsoni infestation.] Včelár 56(3) : 54-55 [Sk, B]

v52 KOENIGER, N.; RAU, C. (1980) Feldversuch 1979/1980 mit Ameisensäure im Hochtaunuskreis. [Field trials with formic acid [against Varroa jacobsoni] in Hochtaunuskreis 1979/1980.] Allgemeine Deutsche Imkerzeitung 14(5) : 157-159 [De, B, AA1035/81]

Over 2000 colonies in 235 apiaries were treated with formic acid for 3 weeks in September; nearly all the colonies were without brood. Counts of dead mites were made; also a sample of colonies was killed, and the mites were shaken out and counted. Varroa was found in 679 colonies at 95 apiaries; formic acid was shown to be an effective acaricide, and no harmful effects were observed in overwintering bees during the 6 months following treatment.

v53 KOTOVA, G.N.; ANTONOVA, I.A.; GROBOV, O.F.; KOLOMIETS, A.YU.; IVANOV, YU.A. (1981) [Formic acid for Varroa jacobsoni infestations.] Pchelovodstvo No. 11 : 21-22 [Ru, B]

3.66 continued

v54 KRÄMER, K. (1980) Varroabekämpfung mit Ameisensäure. [Varroa control with formic acid.] Biene 116(8) : 340-343 [De, B, AA258L/82]

v55 KRÄMER, K. (1980) Nachlese zur Bekämpfung der Varroa-Milbe mit Ameisensäure. [Further information on the control of Varroa mite with formic acid.] Biene 116(8) : 343-344 [De, B, AA259L/82]

v56 KUNZLER, K.; MOOK, H.; BRESLAUER, H. (1979) Untersuchung über die Wirksamkeit der Ameisensäure bei der Bekämpfung der Bienenmilbe Varroa jacobsoni. [Study of the effectiveness of formic acid on the control of the bee mite Varroa jacobsoni.] Biene 115(9) : 372-373 [De, B, AA1346/80]

At least 3 plastic (bee-proof) dishes containing formic acid were put in different parts of the hive. Rate of evaporation was controlled by altering the level of acid or the size of the dish; the resulting concentration of acid in the hive atmosphere was measured. A concentration of 50 μg formic acid/l air was lethal for V. jacobsoni, but did not harm the bees.

v57 MAUL, V.; KRÄMER, K. (1980) Ameisensäure in der Bekämpfung der Varroatose. [Formic acid for the treatment of varroa disease.] Biene 116 : 292-295; 340-343; 343-344 [De, B, AA1036L/81]

v58 MAUL, V.; PETERSEN, N.; WISSEN, W. (1980) Feldversuche zur Varroatosetherapie mit Ameisensäure. [Field trials with formic acid for the treatment of varroa disease.] Allgemeine Deutsche Imkerzeitung 14(5) : 155-157 [De, B, AA1034/81]

Colonies rearing brood were treated with 98% formic acid for at least 3 weeks; in those without capped brood, treatment was for 1 week. Altogether 569 colonies were treated using 2 evaporation methods. The daily target dose of 20-30 ml formic acid/colony was not achieved, levels reaching only 6-8 ml/day on average. Consequently mite mortality, though high in many colonies, was variable. It also seems possible that there may be a seasonal factor in the effectiveness of the treatment.

v59 RITTER, W.; RUTTNER, F. (1980) Neue Wege in der Behandlung der Varroatose. Ameisensäure. Labor- und Freilandversuche. [New methods for the treatment of varroa disease. Formic acid - laboratory and field tests.] Allgemeine Deutsche Imkerzeitung 14(5) : 151-153 [De, B, AA1033/81]

In laboratory tests, 98% formic acid showed low toxicity to bees and high toxicity to Varroa. Field trials of formic acid at 25% and 70% concentrations gave poor results, but high mite mortality was achieved when colonies with or without brood were treated in summer with 98% acid. The acid was introduced as a vapour by means of a wick dipping into a flask containing the acid; an improved method of application is needed. Winter treatment was successful in some colonies, but results varied.

Of 6 honey samples from treated colonies, formic acid was not detectable in 2; in 2 others the allowed limit of 40 ppm was exceeded (47 and 64 ppm).

v60 SULIMANOVIĆ, D.; PECHHACKER, H.; HÜTTINGER, E. (1981) New method for the control of Varroa disease during winter. Pages 366-370 from "Proceedings of the XXVIIIth International Congress of Apiculture, Acapulco, 1981", Bucharest, Romania : Apimondia Publishing House [En, B, AA618/84]

3.66 continued

Methyl formate, ethyl formate, methyl acetate, and the same substances mixed with formic acid, were used in November-January in Yugoslavia, to fumigate honeybee colonies infested with V. jacobsoni. The substances were each placed in a 100-ml flask fitted with a glasswool wick. After 5-6 weeks K-79 (chlordimeform hydrochloride) was used to kill remaining mites as a check. Compared with K-79, methyl formate was 58% effective, ethyl formate 25%, and methyl acetate and the 3 mixtures were comparatively ineffective. Adequate ventilation of hives was necessary in order to prevent harm to the bees.

v61 WACHENDÖRFER, G.; KAISER, E.; KRÄMER, K.; SEINSCHE, D. (1983) Labor- und Feldversuche mit einem von Krämer modifizierten Ameisensäure-Dämm-platten-Verfahren zur Varroatosebekämpfung. [Laboratory and field tests of a method, modified by Krämer, using formic acid for control of Varroa.] Allgemeine Deutsche Imkerzeitung 17(11) : 339-344 [De, B, AA1342/85]

An evaporator containing 98% formic acid was placed in each test hive for 21 days; the daily evaporation rate was 6-9 g. In 24 colonies, 52-100% of mites present were killed by this treatment, but in 5 colonies at one site the mean percentage killed was only 43.7%; the overall mean was 83%. A few queens were lost if treatment was carried out in the spring, but not in the autumn.

v62 WACHENDÖRFER, G.: KAISER, E.; KOENIGER, N.; KLEPSCH, A.; MAUL, V. (1984) Derzeitiger Stand der Untersuchungen zur Wirksamkeit und Verträglichkeit mit einem von Krämer modifizierten Ameisensäure-Dämmplatten-Verfahren zur Varroatosebekämpfung. [Update of investigations on the efficacy of the modified Kramer method of Varroa control, using sheets of absorbent compressed wood containing formic acid.] Deutsche Tierärtzliche Wochenschrift 91(5) : 189-193 [De, en, B, AA1333/85]

In Krämer's modified method (1984) a piece of absorbent compressed wood containing formic acid is put into the hive for 21 days. In these tests, in late autumn, the rate of evaporation of formic acid was relatively constant: 7.9 g/day in field trials. For 10 moderately infested colonies treated in the laboratory, the mean percentage of mites killed was 95.4%; for 15 colonies in field tests, the figure was 92.6%. In 3 years of field trials (Krämer, 1984) involving 424 colonies treated by this method, only 2 queens were lost; however, in laboratory tests 5 out of 10 queens were lost.

v63 WACHENDÖRFER, G. (AND 5 OTHERS) (1985) Neuere Erkenntnisse zur Chemotherapie der Varroatose. [New knowledge of the chemotherapy of varroa disease.] Berliner und Münchener Tierärztliche Wochenschrift 98(9) : 303-306 [De, B, AA/86]

Describes the use of "mite plates" for the evaporation of formic acid; they are soft fibrous insulating material saturated with the required concentration of formic acid. Krämer's and Illertissen's modifications make the method safer for bees. The latter killed fewer mites.
Immediately after treatment, formic acid levels in honey in the hive were high, and then decreased. To conform with legal limits for acid content of honey, it is recommended that colonies are treated after the honey flow.

3.67 PHENOTHIAZINE (THIODIPHENYLAMINE, VARITAN); VAROASIN (PHENOTHIAZINE + PARAFORMALDEHYDE); VARROATIN (PHENOTHIAZINE + 2,4,6-TRIMETHYL-1,3,5-TRIOXANE)

v64 BLAŽEVIĆ, R.; SULIMANOVIĆ, D. (1983) Lijekovi "Krke" protiv varooze. ["Krka" preparations against varroa disease.] Veterinarski Arhiv 53(Supplement) : S21-S22 [Sh, en, B, AA241L/85]
Varitan and Varvapin (phenothiazine plus malathion) smoke preparations.

v65 BULGARIA, SYMPOSIUM ON VAROASIN (1980) Varoasin and control of Varroatosis [varroa disease] in bees. Symposium, 28-29 March 1980, Sofia, Bulgaria : 42 pp. [En, Bg, Ru, Fr, B, AA1026/81]
Summaries are given of 4 papers describing the use of a Bulgarian preparation, Varoasin fumigation tablets, which contain phenothiazine and paraformaldehyde. It is claimed that their use in spring and autumn reduces V. jacobsoni infestations to a "bearable" level.

v66 DANIELYAN, S.G.; MARKOSYAN, A.A.; NALBANDYAN, K.M.; AKOPYAN, N.M. (1975) [Gas smoke generator for treating bees.] Veterinariya, Moscow, USSR No. 8 : 67 [Ru, B, AA943L/78]
Describes a smoker modified to use phenothiazine, for bees infested with Braula or Varroa.

v67 DANIELYAN, S.G.; NALBANDYAN, K.M. (1980) [Phenothiazine tablets in the smoker.] Pchelovodstvo No. 11 : 15 [Ru, B]
For control of V. jacobsoni infestations of honeybees.

v68 ESPINOZA CAMARENA, J.; MEZA PECH, I.; LINERA, D.R. (1981) Winter combined method of control of Varroa jacobsoni Oud. Pages 329-332 from "Proceedings of the XVIIIth International Congress of Apiculture, Acapulco, 1981", Bucharest, Romania : Apimondia Publishing House [En, B, AA615/84]
In mid-August 1980, in Argentina, 12 colonies with various infestations of V. jacobsoni were fumigated with phenothiazine daily until no more mites were found. All sealed and unsealed brood was then removed and destroyed, and the frames were replaced by sterilized shallow framed combs from which honey had been extracted. Two more treatments with phenothiazine at 3-day intervals were made as a precaution. The 10 colonies which survived the treatment developed normally and yielded a mean of 36 kg honey; one colony became re-infected in the following autumn.

v69 GLEBOVA, N.A.; NENILINA, T.V.; BARABANOVA, V.V. (1977) [Comparison of the acaricidal action of chemicals used in Varroa disease of honeybees.] Sbornik Nauchnykh Trudov. Sib. NIIVI No. 31 : 86-91 [Ru, B, AA962/80]
Phenothiazine was 93% effective, varroatin 71.5% and sulphur 51%. Even a three-fold application of phenothiazine did not free the bees completely of the mites.

v70 MEL'NIK, V.N. (1979) [Effectiveness of some ways of attacking varroa disease in honeybees.] Pchelovodstvo No. 1 : 12-14 [Ru, B, AA974/80]
Heat treatment, and treatment with phenothiazine, Sineacar and Varroatin were compared. None was completely effective. The best time for treatment is May; in infested colonies all brood should be removed and destroyed.

3.67 continued

v71 MILITELLO, J.R. (1984) Fumigador antiparasitario. [An anti-parasite [*Varroa jacobsoni*] smoker.] Pages 280-285 from "Anais do 5° Congresso Brasileiro de Apicultura, Viçosa, MG, Brasil, 23 a 27 de julho de 1980" ed. L.S. Gonçalves et al., Viçosa, MG : Brazil Universidade Federal de Viçosa [Es, en, pt, B, AA627L/86]

The apparatus consists of a lower chamber containing combustible material, an upper chamber containing phenothiazine, or similar material, and a nozzle on the end of a flexible tube.

v72 MUSIENKO, V.N. (1983) [Effectiveness of thermal phenothiazine strips against varroa disease of honeybees.] Visnik Sil's'kogospodars'koi Nauki No. 11 : 52-53 [Uk, AA637/86]

Smoke fumigation with 0.2-0.4 g phenothiazine per colony controlled *V. jacobsoni* by 70-95%, without harming bees. Smoke strips were prepared by applying 0.2 g phenothiazine in acetone to paper impregnated with 1% potassium nitrate.

v73 RAKHMATULIN, R.G. (1978) [Effectiveness of preparations [for treatment of] varroa disease.] Pchelovodstvo No. 2 : 12-13 [Ru, B, AA1038/79]

Varroatin can be 70-90% effective. It should be used at temperatures between 20° and 25°C, and with frames spaced 2.5-3 cm apart. The aerosol should be aimed at an angle of 45° between the frames for 1-1.5s, and applied in the evening or early in the morning, in early spring and early autumn; the preparation must reach open cells with larvae. Varroatin has no adverse effect on workers, queen, brood, quality of honey, nor on the operator, two of whom can treat 100 hives in 1.5 h.

Sulphur treatment was less effective and reduced productivity, especially in weak stocks. It was given 2 or 3 times in spring and in autumn at intervals of 8-9 days in a dose of 0.2 g per chamber. Dead mites were found up to 5 days after treatment.

Phenothiazine was not as effective against the mites, and it killed 20% of queens as well as reducing the lives of workers. Use of naphthalene is forbidden in the USSR because of its effect on honey.

v74 RAKHMATULIN, R.G. (1978) [Trials of preparations for control of *Varroa* infestation of honeybees.] Veterinariya, Moscow, USSR No. 3 : 71-73 [Ru, B, AA965/80]

Large-scale tests carried out on more than 500 000 colonies during 1975 to 1976 in 30 districts of the RSFSR showed that Varroatin was more effective in controlling *Varroa* infestation of honeybees than sulphur. It was non-toxic to honeybees and did not affect the quality of honey, or queen-rearing, reproductive or honey-collecting activities. Its efficiency ranged from 70 to 96%. Phenothiazine gave good results in some tests.

v75 REZINKIN, G.S. (1978) [Acaricide treatment of honeybees infested with *Varroa*.] Veterinariya, Moscow, USSR No. 3 : 75-76 [Ru, B, AA958/80]

Treatment of infested honeybee colonies with phenothiazine aerosol (dose not stated) effectively controlled *V. jacobsoni*. The fumigant Acarotox (ether sulphonate), applied in the spring at a rate of 1 tablet per 12-frame hive, 7 times in 48 h, was also effective, but Varroatin did not give good results. It is stated that in early spring and late autumn all sealed brood should be removed before colonies are treated, and in summer it is best to treat colonies after the main honey flow, when there is least brood.

3.67 continued

v76 SIMETSKIĬ, M.A.; SMIRNOV, A.M.; KUDRYAVTSEV, E.A. (1976) [How best to apply Varroatin.] Pchelovodstvo No. 7 : 16-18 [Ru, B, AA1301L/78]
For destroying Varroa mites.

v77 SIMETSKIĬ, M.A.; SMIRNOV, A.M.; KUDRYAVTSEV, E.A. (1977) [Control of the mite Varroa jacobsoni on honeybees.] Veterinariya, Moscow, USSR No. 4 : 78-80 [Ru, B, AA1030379]
A formula was elaborated for a mixture of unspecified composition termed Varroatin, applied as an aerosol to the combs, and in a series of tests this gave up to 99.6% mortality of mites. For the best results, colonies should be treated when no brood is present - in April and May, or in September and October, after the brood has emerged. Varroatin should be applied 4 times at 24-h intervals.

v78 SMIRNOVA, O.I.; MAKHNO, P.M.; SIMETSKIĬ, M.A.; SMIRNOV, A.M.; KUDRYAVTSEV, E.A. (1978) [Mechanism of the action of Varroatin on the Varroa mite.] Pchelovodstvo No. 2 : 8-11 [Ru, B, AA1037/79]
Photographs show various parts of the mite, including cuticle, fatty tissues, nerve ganglia, muscles, ovary, oviduct, accessory gland and vagina. Photographs of these parts after treatment with Varroatin show signs of degeneration such as vacuolization of the cytoplasm, rupture of muscular tissues and epithelial disintegration.

v79 TASHIRO, K. (1985) New strategy for more efficacious control of Varroa jacobsoni with ZPK (phenothiazine preparation). Page 75 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]
This preparation has been used for treating varroa infestation since 1968 in some tens of thousands of colonies; no direct damage to queens and little effect on brood has been reported. Some colonies have been treated for 10 years, but still have varroa mites. An improved treatment regime and combination treatment with other drugs is now recommended.

v80 TSIVILEV, I.V. (1968) [Phenothiazine for controlling Varroa and the bee louse.] Pchelovodstvo 88(6) : 17 [Ru, B, AA990L/71]

v81 ZUJIĆ, N.; DELAK, M.; SULIMANOVIĆ, D. (1981) Djelovanje dima fenotijazina na parazite Varroa jacobsoni. [Effect of phenothiazine fumigation on Varroa jacobsoni.] Veterinarski Arhiv 51 : 134-137 [Sh, en, B, AA1340/82]
The fumigants tested were phenothiazine preparations containing oxygen donors to improve burning. They were less effective than a commercial preparation from Japan (Danikoropa). Satisfactory results were obtained by using 2 g phenothiazine per colony. The phenothiazine should be put onto strongly glowing coal.

v82 ZUNINO AGUIÑAGALDE, P.J. (1984) Varroa jacobsoni - un aparente efecto secundario de su presencia en la colmena. [An apparent secondary effect of the presence of Varroa jacobsoni in hives.] Pages 262-264 from "Anais do 5° Congresso Brasileiro de Apicultura, Viçosa, MG, Brasil, 23 a 27 de julho de 1980" ed. L.S. Gonçalves et al., Viçosa, MG, Brazil : Universidade Federal de Viçosa [Es, en, pt, B, AA626/86]
In Uruguay, in 1979-80, a large increase in V. jacobsoni occurred; in some colonies 30% of sealed brood was infested. Treatments using the acaricide chlorobenzilate were of little value, and adversely affected the activity of worker bees. Phenothiazine was more effective in controlling the mites and did not harm the bees. The antibiotic tetracycline, used in a mixture with sugar, "normalized" the hive populations without causing mortality of workers or drones.

3.68 SULPHUR

v83 ELISEEV, V.K. (1978) [Control of varroa disease of honeybees with sulphur.] Sbornik Nauchnykh Trudov, Moskovskaya Veterinarnaya Akademiya 99 : 128-129 [Ru, B, AA631/81]

Powdered sulphur (1 g per hive) was evenly scattered over the top-bars of the brood chamber. When repeated twice, at 10-day intervals, colonies in early stages of infestation by Varroa were cleared of the mite.

v84 GROBOV, O.F.; MIKITYUK, V.V.; LIKHOTIN, A.K. (1978) [Use of purified sulphur against varroa disease of honeybees.] Veterinariya, Moscow, USSR No. 1 : 71-73 [Ru, B, AA575/80]

Honeybees kept in a cage 11 x 8 x 8 cm containing 100 mg sulphur were only slightly affectd, but Varroa mites were killed. Field experiments also gave positive results. It was concluded that purified sulphur can be used in hives, at 0.1 g per frame for prophylaxis, and at 0.2 g for therapy, with an interval of 12-14 days between applications, at a time when the bees are flying well. It should not be applied when the ambient air temperature exceeds 30-33°C. A single treatment with sulphur may be given in early spring. The maximum permissible dose of purified sulphur per hive in the USSR is 3 g (southern regions) or 5 g (central and northern regions). The sulphur is distributed uniformly on the top-bars of the frames. After treatment it is essential to place the bees on clean combs, uncontaminated with sulphur.

v85 MIKITYUK, V.V.; SEDIN, I.F. (1977) [Use of ground sulphur against Varroa disease of honeybees.] Veterinariya, Moscow, USSR No. 5 : 69-70 [Ru, B, AA1032/79]

When applied as a dust at 0.1 g/1440 cm^3, ground sulphur killed all the mites, doses of 500, 100 and 50 and 10 mg on 5 x 5 cm of uncovered brood caused complete brood mortality in 48 h. When sulphur was mixed with an emulsifying agent, diluted 1:100 000, and applied at doses of 110 or 130 µg, mite mortality was 79.9-75.6%. Worker bees appeared unaffected.

When sulphur was used as a fumigant at 0.1 g/1440 cm^3 at 35°C and 86% RH, mite mortality was 100%, and bee mortality 11.6%. Mite mortality decreased with decreasing temperature.

When refined sulphur was given to worker bees at a concentration of 0.1% in 1:1 sugar syrup, average life-span was reduced from 23.6 days (control) to 0.9 days.

v86 MIKITYUK, V.V. (1980) [The application of sulphur in the treatment of Varroa infestations under the conditions of the central black-earth zones.] Trudy Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 52 : 96-100 [Ru, B, AA241/82]

Flowers of sulphur was tested on 28 285 infested colonies of honeybees. Three methods of application were compared: (1) sprinkling the powder on the frame top-bars at 0.2 g per bee way; (2) rubbing the sulphur into a cloth covering the frames, at 10 g per hive; (3) sprinkling 10 g onto sticky paper on the hive floor. Trials were made in April, July and October, 1975. At all seasons method 2 was the most effective. Method 1 was least effective in April, and method 3 in July and October. Treatment with sulphur was as effective as treatment with Varroatin.

v87 PETROV, S.G. (1976) [Sulphur against the Varroa mite.] Pchelovodstvo 96(4) : 18 [Ru, B, AA1311L/77]

v88 SAKAI, T.; TAKEUCHI, K. (1980) [Varroa jacobsoni and its control in Japan.] Honeybee Science 1(4) : 145-150 [Ja, en, B, AA254/82]

3.68 continued

In Japan, this mite was found on both Apis mellifera and Apis cerana in the 1950s; it spread rapidly throughout the country. Treatments included smoking with sulphur-containing acaricides or spraying with certain pesticides. Such pesticide treatments killed many Apis mellifera before more suitable application methods were found.
Many beekeepers now use a series of different pesticides to avoid the development of Varroa resistance to a single chemical, although the necessity for this has not been established scientifically. Generally, a smoke or spray is applied in October - November when the mite is easy to see, in February - March when colony build-up starts, and in the summer.

v89 SMIRNOV, A.M. (1975) [Destroying Varroa mites away from hives.] Pchelovodstvo 95(11) : 20-22 [Ru, B, AA1302/77]
The mites survived for 7 days in an empty hive, 6-7 days on comb, 15 days on open brood, 32 days on capped brood and 11 days on adult and larval honeybees. Equipment was successfully treated by fumigating for up to 24 h with methyl bromide (100-200 g/m^3) or with 150-200 g sulphur gas/m^3; it was then allowed to stand for 2-3 days before use.
Open ground in the infected apiary was treated with a flame gun: 3.5 min on open ground without grass, 5.5 min on damp ground, 5 min on green grass and 12 min on wet grass.

v90 VAS'KOV, N.A.; STOLBOV, N.M.; TEREBOV, A.S. (1978) [Purified sulphur for varroa disease in bees in greenhouses.] Pchelovodstvo No. 7 : 22-23 [Ru, B, AA1341/80]
Winter treatment of infested colonies with 5-10 g pure sulphur per colony killed Varroa mites, but the honeybee cluster was disturbed. Therefore, the treatment is feasible only shortly before the colony is to be used for pollination, and the combs must be destroyed. When the bees were active in the glasshouse, they were given three doses of 0.4 g sulphur, which did not affect the plants. A single dose of 0.2 g was ineffective against Varroa. For treatment in autumn, a dose of 10 g/kg of bees was applied outside the colony.

3.69 OTHER AGENTS

v91 ALEKSEENKO, F.M.; YAROSHENKO, V.I.; MUSIENKO, V.M. (1982) [Testing new acaricides for the treatment of honeybee infestation with Varroa mites.] Visnik Sil'skogospodars'koi Nauki (10) : 85-87 [Uk, B, AA/86]

v92 ARZONE, A. (1982) A proposito di lotta chimica contro Varroa jacobsoni Oud. [Chemical control of Varroa jacobsoni.] Apicoltore Moderno 73(2) : 45-48 [It, en, B, AA1294L/83]
Beekeepers are urged not to use pesticides for controlling V. jacobsoni, as many are also toxic to honeybees.

v93 ARZONE, A. (1984) The danger of using pesticides to control Varroa jacobsoni Oud. Apiacta 19(2) : 41-45 [En, B, AA971/85]
Of the 40 products that have been used against V. jacobsoni, 18 are also used to control plant pests; these are listed and their uses and properties discussed. The results of previous laboratory tests have shown that endosulfan, malathion, phosalone and tetradifon are particularly persistent and have high oral toxicities for honeybees. It is thus considered inadvisable to use these and similar pesticides in hives to control V. jacobsoni infestations.

3.69 continued

v94 BAKANDRITSOS, N. (1985) [Effect of antiparasitic drugs against Varroatosis of bees. Deltion tes Ellenikes Kteniatvikes Etaireias 36(3) : 105-111 [Gr, en, B]; see also page 74 from "XXXth International Apicultural Congress; program and abstracts report" (1985) [En, B]

Five drugs were used experimentally. They were applied to brood, and to colonies with and without brood. The active ingredients, in brackets, and the percentage of mites killed by each drug was as follows: Acarocil (0.18% albentazole + 0.0025% malathion): 6-60%; Sineacar (bromopropylate 0.115% + chloropropylate 0.1425% + tetradifon 0.02%): 70-100%; Taktic (amitraz 12.5%): 92.5-100%; Asuntol 50 (0,0 diethyl-0-3-chloro-4-methyl-7-cumarinil sulfophosphoric salt, 50% wettable powder): 81-100%; "Folbex VA" (bromopropylate mg 370): 91-97%.

Treatment was carried out 2 to 7 times, and the number of larvae treated each time was 400-800.

v95 BAKANDRITSOS, N.; ZABUNIS, A. (1985) The tobacco leaves' effectiveness in the control of varoatose of honeybees. An experimental study. Page 76 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Between 65 and 95% of mites were killed by treatment with tobacco smoke.

v96 BALABAEV, V.A. (1976) [Aerosol treatment [for Varroa disease].] Pchelovodstvo No. 5 : 28-29 [Ru, B, AA261L/78]

v97 BOAGIU, A. (1982) Amanunte in practica folosirii Sineacarului. [Details in the practical use of Sineacar.] Apicultura în România 57(9) : 14-15 [Ro, B]

v98 CHIRIŢA, D. (1981) Varrooza şi Sineacarul. [Varroa jacobsoni infestation and Sineacar.] Apicultura în România 56(7) : 19 [Ro, B]

v99 DE JONG, D.; SEINER, J.; GONÇALVES, L.S.; MORSE, R.A. (1984) Brazilian Varroa research rates current treatments too expensive. American Bee Journal 124(2) : 111-112, 138-139 [En, B, AA576/85]

Results so far have indicated that Varroa infestations in Brazil cause some loss in production, but colony mortality is rare. Sineacar was ineffective in Brazilian conditions, and other chemical treatments tested were not worth the cost.

v100 GROBOV, O.F.; SHABNIĬ, M. YA.; VYAZOVSKIĬ, E.N. (1979) [Sineacar for use against Varroa.] Pchelovodstvo No. 12 : 18-19 [Ru, B, AA1021L/81]

Sineacar (Romanian product) was harmless to bees, but was not 100% effective in killing Varroa mites.

v101 GROBOV, O.F.; AND 9 OTHERS (1980) [Thymol for the control of Varroa jacobsoni infestations in different zones [of the USSR].] Pchelovodstvo No. 9 : 10-11 [Ru, B]

v102 HO, K.-K.; HSU, E.-L.; AN, J.K. (1980) [Chemical control of Varroa jacobsoni. 1. Screening tests of acaricides on V. jacobsoni and toxicity of 5 acaricides to Apis mellifera.] Phytopathologist and Entomologist, National Taiwan University : 78-83 [Ch, en, B, AA934/82]

In a survey of 52 apiaries, V. jacobsoni was found in all of them. Topical toxicity tests on honeybees were carried out in the laboratory using 51% Gubitol, 27% Acarthane, 25.5% Folbex, 35% dicofol and 50%

3.69 continued

Plictran, and the acaricides were also tested in the infested apiaries. Gubitol was the least toxic to adult worker bees and is recommended for use in apiaries.

v103 HO, K.-K.; AN, J.K. (1980) [Effects of Gubitol and of its application methods on Varroa jacobsoni in Taiwan.] Honeybee Science 1(4) : 155-156 [Ja, en, B, AA255/82]

Gubitol is 0,0-diethyl-0-(3-chloro-4-methyl-7-coumarinylphosphorothioate); a 51% wettable powder was used to control the mite. Each frame was treated twice with 25-30 ml of a 0.001% solution with an interval of 7 days, in spring and in autumn. Mortalities of honeybee eggs and larvae were 29.2% and 57.5% respectively if the chemical was applied directly to the cells. Mortality in unsealed brood was 23.6% when sprayed from a vertical position and 6.9% when sprayed at an angle.

v104 IFANTIDIS, M.D.; THRASYVOULOU, A.; PAPPAS, N. (1985) Preliminary data on a new approach to destroy the varroa mite within the space of its reproduction. Page 78 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

It is known that most varroa mites remain in the honeybee larval food for 1 or 2 days. When colonies were fed in winter with pollen containing 50 ppm malathion, mites were killed. No damage to bees was observed. With prolonged contact between the pesticide and parasite, solutions at very low concentrations (0.05 ppm malathion) were very toxic to the mite.

v105 IVANOV, YU. A. (1981) [A study of the acaricidal properties and toxicity to honeybees of some synthetic fragrances.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 65-68 [Ru, B, AA565/85]

Of the 5 substances studied - citral, citronellal, terpineol, ionone and elenol - only ionone and elenol proved effective against V. jacobsoni, but they were also rather toxic to bees.

v106 KAMBUROV, G.; KUNCHEV, K.; STOIMENOV, V. (1975) [Testing of chemicals for control of Varroa jacobsoni infection in honeybees.] Acta Microbiologica, Virologica et Immunologica 2 : 100-104 [Bg, en, ru, B, AA573/78]

Of 8 acaricide formulations tested, fumigation preparations containing 1.25 g Milbex were the most effective in controlling V. jacobsoni infesting honeybee colonies. Best results were obtained by treating colonies 2 or 3 times at 2-day intervals in the autumn.

v107 KAMBUROV, G.; DANCHEVA, L. (1979) [Naphthalene for control of varroa infestations.] Veterinarna Sbirka 77(3) : 36-37 [Bg, B]

v108 KLOCHKO, R.T.; LUGANSKII, S.N.; BOCHAROV, N.M. (1983) [Toxicological evaluation of oxalic acid.] Pchelovodstvo No. 7 : 14-15 [Ru, B]

Used to control V. jacobsoni infestations of honeybees, USSR.

v109 KOENIGER, N.; KLEPSCH, A.; MAUL, V. (1983) Zwischenbericht über den Einsatz von Milchsäure zur Bekämpfung der Varroatose. [Interim report on the use of lactic acid for treating varroa disease.] Biene 119(7) : 301-304 [De, B, AA945/84]

Of the 3 acids tested, 2% oxalic acid and 2% sulphuric acid were unsuitable. For lactic acid, solutions were tested by spraying about 5 ml onto each side of each comb occupied by bees; a 10% solution killed about 50% of mites, and a 15% solution killed over 60%. There was no

3.69 continued

damage to brood, but the higher concentration of lactic acid had an adverse effect on adult bees. As with some other treatments for *Varroa*, lactic acid is effective only on uncapped brood, and in these tests was applied in the spring.

v110 KOPTEV, V.S.; KHARCHENKO, G.I.; SAFATOVA, T.F. (1979) [Naphthalene fumes for the control of varroa infestations.] Pchelovodstvo No. 10 : 24-25 [Ru, B]

v111 LANGE, A.B.; NATSKIĬ, K.V.; TATSIĬ, V.M. (1977) [An evaluation of preparations for controlling *Varroa* disease of honeybees.] Veterinariya, Moscow, USSR No. 9 : 73-77 [Ru, B, AA1031/79]

V. jacobsoni females, which fast in the absence of honeybee brood during the winter, start to ovipost after engorgement on the first bee brood. In untreated hives, infestation increased about 6-fold in a year. The control measures with various acaricides which were tested did not give significant improvements, and it is suggested that tests should be carried out in the spring, during and after treatment 3 times at weekly intervals.

v112 LUGANSKIĬ, S.N.; SMIRNOV, A.M. (1984) [Toxicity of oxalic acid.] Pchelovodstvo No. 12 : 17 [Ru, B]

Oxalic acid is widely used in the USSR for treatment of *Varroa* infestations, therefore it could contaminate brood cells and honey. Experiments with oxalic acid on rats and mice showed that it is highly toxic, with a slow cumulative effect and an LD_{50} of about 950 mg/kg. A 2% aqueous solution of oxalic acid did not cause any skin lesions.

v113 MARCHETTI, S.; BARBATTINI, R.; D'AGARO, M. (1984) Prove preliminari sull'impiego di alcune specie vegetali nel controllo di *Varroa jacobsoni* Oud. [Preliminary trials on the use of some plant species for the control of *Varroa jacobsoni*.] Pages 56-67 from "Apicoltura sana - agricoltura produttiva, Atti del Convegno Internazionale dell'Apicoltura, Lazise, 29 settembre - 2 ottobre, 1983", Milan, Italy : Studio Edizioni [It, en, B, AA952/85]

Results are given for 10 plant species that were used in a smoker for fumigating honeybee colonies infested by *Varroa jacobsoni*; *Rosmarinus officinalis*, *Melissa officinalis*, *Mentha piperita*, *Equisetum arvense*, *Achillea clavenae*, *Artemisia absinthium*, *Lycopersicon esculentum*, *Pinus mugo*, *Satureja montana*, *Salvia officinalis*, *M. officinalis* and (especially) *M. piperita* caused some mites to become detached from adult bees if the hive was closed for 60 min after smoking, but none of the fumigations were effective if the hive remained open.

v114 MARIN, M. (AND 5 OTHERS) (1975) Medicament destinat combaterii acariozelor la familiile de albine şi procedeu de obţinere a lui. [Composition for treating mite diseases of honeybees and method for preparing it.] Romanian Patent No. 63434 : 3 pp. [Ro, B, AA963/80]

A composition for the control of mites on honeybees consists of 0.5% sodium pyrosulphite, 0.272% of an 8% solution of 2,4,4',5-tetrachlorodiphenylsulphone, 0.15% of a 50% solution of isopropyl-4,4'-dibromobenzilate, 0.075% of a 50% solution of 2-methyl-4-chlorophenyldimethylformamide, 0.5% of a 25% solution of isopropyl-4,4'-dichlorobenzilate, and sugar. The composition controlled *V. jacobsoni* and *A. woodi* on honeybees.

3.69 continued

v115 MARIN, M. (1981) Control of Varroa disease with Sineacar. Successful results obtained in Romania and other countries. Apiacta 16(2) : 53-54, 56 [En, B]

v116 MIKAWA, F. (1985) Control of Varroa jacobsoni with emulsified mixtures. Page 75 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Emulsions containing various combinations of Danicut V-20, Acar-45, and Tedion were effective against the mite. Five grams of a mixture was put on corrugated paper (5 x 5 cm) for a single hive, and 7 g on 6 x 6 cm paper for a double hive; the treated paper was inserted into the hive entrance immediately. Mixtures were applied 3 to 4 times in rotation at 4 to 5 day intervals.

v117 MIKITYUK, V.V.; GROBOV, O.F.; CHIGAREVA, O.I. (1979) [Trials of chemicals for controlling Varroa jacobsoni infestations of bees.] Trudy Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 50 : 120-125 [Ru, B, AA576/82]

Thymol was effective against infestations of V. jacobsoni when applied at 7-40°C at a rate of 0.25 g in each beeway between combs. It was either scattered onto the upper bars, or onto muslin or metal gauze, and applications could be repeated with 7-day intervals. Thymol was about twice as effective as sulphur, and as Varroatin.

v118 MIKITYUK, V.V.; KORZHOVA, L.N.; SEDIN, I.P. (1981) [Some plants for controlling Varroa jacobsoni.] Pchelovodstvo No. 8 : 20-21 [Ru, B]

v119 MIKITYUK, V.V. (1983) [Efficiency of thymol against varroa disease.] Veterinariya, Moscow, USSR No. 1 : 43-44 [Ru, B, AA1286/83]

Thymol contained in a muslin pack (30 x 30 cm) hung over the brood frames was up to 90% effective against V. jacobsoni in the Kalyzhsk region and did not harm the bees, but the same treatment in the Krasnodarsk region killed some bees and inhibited egg laying by the queen. Experiments were carried out to determine the effect of the following factors on the rate of sublimation of thymol: the dimensions of the pack, the air temperature, RH, strength of the colony. All except RH affected the results. Treatment with thymol is not recommended if the air temperature is above 27-30°C, especially if the colony is weak.

v120 MOLIBOGA, O.A (1980) [Ledum sp. for control of mites.] Pchelovodstvo No. 9 : 20-21 [Ru, B]

V. jacobsoni in honeybee colonies.

v121 NEDELCHEV, N.; NAIDENOV, N. (1981) [A new preparation.] Pchelarstvo 79(3) : 3-5 [Bg, B]

The preparation which is called Antivar, is for control of V. jacobsoni infestations of honeybees in Bulgaria.

v122 NIJHUIS, H.; ENSS, K.; VOSS, S.; TIETGEN, I.; TIETGEN, W. (1985) Untersuchungen zur Bekämpfung der Varroa jacobsoni mit Hilfe von Pyrethrum-Extraten. [Investigation of the control of V. jacobsoni using pyrethrum extracts.] Biene 121(2) : 55-56 [De, B, AA1335L/85]

v123 NOVIKOV, V.S.; BARABANOVA, V.V. (1980) [Lemon essence for the treatment of varroa infestation of honeybees.] Sbornik Nauchnykh Rabot. Sibirskii Nauchno-Issledovatel'skii Veterinarnyi Institut No. 38 : 157-159 [Ru, AA587L/85]

3.69 continued

v124 POLJAKOV, A.A. (AND 9 OTHERS) (1978) Akarizides Präparat zur Diagnostik und Bekämpfung von Ektoparasiten der Bienen. [Acaricide preparations for the diagnosis and control of ectoparasites of honeybees.] German Federal Republic Offenlegungsschrift No. 2719722 : 16 pp. [De, B, AA1170/80]

N-methylcarbamates control infestation of honeybees by Acarapis woodi and by V. jacobsoni. Thus, application to hives of a composition containing 0.025% by weight methyl-N-methylcarbamate, 19.975% acetone, and 80% difluorodichloromethane, completely controlled these mites. The compounds are also useful for diagnosis, since their application to infested bees led to the appearance of dead V. jacobsoni on the bottom of the hive.

v125 POPESKOVIĆ, D. (1985) Theoretical and experimental foundations for the composition of a new anti-Varroa target systemic agent. Pages 80-81 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

It was established that V. jacobsoni probably breathes by haemocyanin - a transport respiratory pigment with Cu in the centre of the molecule. Since insects do not possess a transport respiratory pigment in their blood, the introduction of a "cupriacceptable" chemical compound through syrup into the blood of a bee would result in the biochemical blockage of the mite's breathing.

Ten "cupriacceptable" compounds and preparations have been tested; they caused a significant decrease in V. jacobsoni.

v126 RITTER, W. (1985) Perizin: Ein neues systemisches Medikament zur Bekämpfung der Varroatose. [Perizin: a new systemic drug for the control of varroa disease.] Tierärtzliche Umschau 40(1) : 14-15 [De, en, B, AA/86]

Perizin is 3-chloro-4-methylumbelliferone-O,O-diethyl thiophosphate.

v127 RITTER, W. (1985) First results from biological trials with Apitol, a medicament with systemic activity. Page 79 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

In laboratory studies it was shown that Apitol is passed from bee to bee through food exchange, and that it affects the parasites via the haemolymph of the bee. A high mite-mortality was achieved at a relatively small dosage. These results were confirmed in both artificial swarms and in colonies on combs.

v128 RUIJTER, A. DE (1982) Tobacco smoke can kill Varroa mites. Bee World 63(3) : 138 [En, B, AA611L/83]

Preliminary results obtained in Thessaloniki, Greece, are reported.

v129 RUIJTER, A. DE (1983) Preliminary results on treatment of Varroa-infected honeybee colonies with tobacco smoke. Pages 63-70 from "Varroa jacobsoni Oud. affecting honey bees: present status and needs" ed. R. Cavalloro, Rotterdam, Netherlands : A.A. Balkema for the Commission of the European Communities [En, B, AA1275/84]

Experiments using laboratory cages at Oberursel, German Federal Republic, confirmed preliminary results obtained in Greece (Ruijter, 1982). In 3 colonies which were smoked 3 times, using 2-5 g tobacco for each application, mortality of V. jacobsoni was 75%. Some bees were also killed when 5 g were used.

v130 RUIJTER, A. DE; EIJNDE, J. VAN DEN (1984) Detection of Varroa mite in the Netherlands using tobacco smoke. Bee World 65(4) : 151-154 [En, B, AA957/85]

3.69 continued

An empty super is added to the hive being investigated, to act as a fumigation chamber and to prevent the bees from being anaesthetized. A piece of cardboard is inserted at the bottom of the hive. At the end of the day, when most bees have returned to the hive, the hive entrance is closed by wet cloth or newspaper, leaving a small opening through which tobacco smoke can be blown using a Dathe pipe connected by a flexible tube to a foot-operated pump. For ordinary hives 3 g tobacco is used for skeps or small single-body hives, 2 g. The hive is re-opened after about 1 h. On the following day the empty super is removed, and the cardboard insert is inspected for *V. jacobsoni* which have been killed by the tobacco smoke. *V. jacobsoni* was first detected in the Netherlands in spring 1983 by beekeepers using this method, but the method is much more sensitive in autumn after most brood rearing is finished.

v131 SADOV, A.V. (1981) [Supplementary feeding of honeybee colonies with essential oils from pine needles as a measure against varroa disease.] Sbornik Nauchnykh Trudov Moskovskaya Veterinariya Akademiya 120 : 39-50 [Ru, B, AA948/84]

Honeybee colonies in which 1-20% of bees were infested with *V. jacobsoni* were fed 0.25% pharmaceutical extracts of pine needles mixed with candy in the second half of winter and in early spring. The author states that this averted the death and exhaustion of the bees, increased the quantity of sealed brood to 1.2-1.5 times as much as in untreated colonies, and increased the honey harvest by 15-50%. Pine essence may be added to a honey + sugar paste, to candy, or to sugar syrup, or applied as an aerosol sprayed onto the combs.

v132 SANTAS, L.A.; EMMANOUEL, N.G.; PAPADOPOULOU-BATZAKI, D.G. (1981) Preliminary observations from the use of two control methods for *Varroa* disease in Greece. Pages 356-360 from "Proceedings of the XXVIIIth International Congress of Apiculture, Acapulco, 1981", Bucharest, Romania : Apimondia Publishing House [En, B, AA617/84]

In February-April 1980, malathion dust (1% a.i.) at 2 g/hive was used to control *V. jacobsoni*, but its residual action was short (c. 36h) and even after 6 applications mites were still present. In June-October 8 applications of malathion dust at 2 g/hive (1% a.i.) or 4 g/hive (0.5%) were used; the latter formulation was more effective in reducing the mean level of infestation in brood. Malathion had no direct adverse effect on honeybees and no residues were found in honey. As it can be used at any temperature, it is recommended for use in winter when the mite does not breed.

A number of devices that released sulphur dioxide slowly into the hive atmosphere over 25-47 days were also used. They contained 50 or 100 g of $K_2S_2O_5$, and had walls 60 or 100 μ thick. Over 80% of mites were killed, and the mean level of infestation in brood was greatly reduced, but toxic effects on adult bees and brood were observed in some hives and care must be taken in the use of such devices.

v133 SCHMID, W.J. (1985) Apitol - a new acaricide with systemic activity against *Varroa* mites. Page 79 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

v134 SIDOROV, N.G.; STOLBOV, N.M.; PLATUKHINA, N.I. (1977) [The effect of volatile oils of higher plants on the *Varroa* parasite of honeybees.] Veterinariya, Moscow, USSR No. 7 : 65-68 [Ru, B, AA1033/79]

3.69 continued

Ethereal oils of certain higher plants were investigated as possible fumigants for use against V. jacobsoni; their effect on honeybees, particularly with reference to the composition of the haemolymph, was also studied. Vapours of mint, aniseed, wormseed, dragon's head (Dracocephalum), citranilic and Chenopodium oil at a rate of 8 ml/0.08 m^3, and of menthol crystals at 8 g/0.08 m^3, had an acaricidal effect, varying from weak (wormseed oil) to strong (Chenopodium oil). The vitality of bees increased after fumigation with vapour of thymol and oil of fir. The density of haemocytes in the haemolymph of infested bees was less than in uninfested bees. The haemolymph of some bees became markedly infected with micro-organisms, especially in autumn, but their numbers declined after the bees had been fumigated with ethereal oils. It is recommended that preparations based on ethereal oils should be introduced into the hive at the height of seasonal activity, at temperatures above 12°C.

v135 STORT, A.C.; GONÇALVES, L.S.; MALASPINA, O.; DUARTE, F.A.M. (1981) Study on Sineacar effectiveness in controlling Varroa jacobsoni. Apidologie 12(3) : 289-297 [En, de, fr, B, AA941/82]

Sineacar powder contains chloropropylate and bromopropylate and Tedion (tetradifon) in cellulose or glucose. Each of 9 Varroa-infested honeybee colonies was treated with 100 g of the powder, which was dusted over the combs; the treatment was repeated 10 days later. Overall, the treatment was ineffective, and infestations were comparable with those of untreated control colonies.

v136 SULIMANOVIĆ, D.; GRBIĆ, D.; TOMAC, I. (1983) Primjena Apiakaridima u suzbijanju ektoparazita pčela. [Use of Apiakaridim [smoke] to control ectoparasites [Varroa and Braula] of bees.] Veterinarski Arhiv 53 (Supplement) : S67-S68 [Sh, en, B, AA238L/85]

v137 TAKEUCHI, K.; HARADA, K. (1983) [Control of Varroa with oxalic acid sprays.] Honeybee Science 4(3) : 113-116 [Ja, en, B, AA623/84]

Oxalic acid solution was sprayed directly onto combs of infested colonies at concentrations [expressed as % of oxalate] of 1.4, 2.0 and 2.8%; mite populations were reduced by 76, 5.6 and 23.8-90.3%, respectively, compared with untreated controls. At 0.7% concentration a small increase in Varroa numbers was recorded. Oxalic acid did not harm the bees; average dose per comb was estimated to be 275 mg or less, using the strongest solution. The effect of the treatment lasted for 3 days, but mite mortality was highest on the first day.

A spray containing chlorophenamidine killed 70.5% of mites, and amitraz 28.5%, but the latter also killed some bees.

v138 YOSHIDA, K. (1986) [Prevention of chalk brood disease and Varroa jacobsoni by products of organic fermentation.] Honeybee Science 7(2) : 79-82 [Ja, en, B]

Malt was produced from rice, soya beans etc. by reaction with gluconic acid, acetic acid and lactic acid bacteria. Small colonies (4 frames) were fed with 3% (vol/vol) of the fermented solution in sugar solution, so that each had 100 ml/day for 90 days. Bees were also sprayed with a 3% solution in water 9 times at 10-day intervals. The number of V. jacobsoni mites decreased to a "20% level" but in a control colony, the number doubled.

3.7 RESIDUES OF CHEMICALS IN HONEY

v139 FLAMINI, C.; ROBIN, S. (1985) Méthode de dosage des résidus d'amitraze dans le miel. [Method for the determination of amitraz in honey.] Bulletin d'Information des Laboratoires des Services Vétérinaires No. 18 : 47-54 [Fr, B, AA/86]

A gas chromatographic method is described for the determination in honey of amitraz (used to treat the varroa mite). In honey samples to which known amounts of amitraz had been added, at least 70% of the amitraz was detected. The method could also be used to determine 2,4-dimethylaniline content (at least 807, detected).

The rate of breakdown of amitraz in honey was also determined.

v140 HAUCK, H. (1982) Folbex VA Neu, keine Gefahr für den Honig. [Folbex VA Neu, no danger for honey.] Biene 118(6) : 248-250 [De, B]

v141 6 LIAKOS, B. (1983) [Studies on toxic residues of malathion in honey.] Hellenike Kteniatrike 26(10) : 308-313 [Gr, en, B, AA274/85]

Two hives with different bee populations were fumigated with malathion 5 times on every fifth day, at doses which increased progressively from 0.05 to 0.4 g. Samples of honey were taken by centrifugation and by squeezing on the fifth and tenth days after the administration, and examined by gas chromatography for malathion residues. In samples which had been extracted by centrifugation there were 0.003-0.008 ppm malathion, while in samples extracted by squeezing there were 0.009-0.05 ppm. Honey samples from apiaries where malathion had been used for treatment against Varroa were tested 2 months after extraction and found to be free from malathion and other pesticide residues.

v142 MALININ, O.A.; YAROSHENKO, V.I.; ALEKSEENKO, F.M. (1981) [Determination of neoron in honey.] Veterinariya, Moscow, USSR No. 9 : 68-69 [Ru, B, AA274/83]

Neoron is described as a mildly toxic substance used as a treatment against Varroa infestations. The oral LD_{50} in rats is 5000 mg/kg. In the concentrations used against Varroa (0.5 g per hive) it is harmless to bees.

A method of detecting residues in honey using gas chromatography is described. After 2-3 applications to hives, residues in honey stored for 6-7 months were 0.028-0.035 mg/kg. With 3-8 applications the quantity found in extracted (centrifuged) and comb honey varied from 0.07 to 0.52 mg/kg. No harmful effects to bees were observed.

After storing for 6 months the content of neoron in honey decreased by 30-60%. This was independent of temperature.

MORITZ, R.F.A. (1982) Präparatverteilung bei systemischer Therapie von Ektoparasitosen bei Apis mellifera L.

The full entry, with annotation, is in 3.62. (After treatment of honeybees, K-79 was found in about 75% of cells.)

v143 NEUHAUSER, H. (1985) Information über den Wirkstoff des Perizin. [Information on the active ingredient of Perizin.] Apidologie 16(3) : 217-219 [De, B]

This is an organophosphorus compound (code number Bay 21/199 and chemical name 3-chloro-4-umbelliferone 0,0-diethylthiophosphate). Bees were treated topically at the normal rate, and 70-74 days later, honey contained 5-16 ppb. No metabolites were found in the honey. The ADI-value is 0.0355 mg/person/day. This means that more than 1000 g honey would have to be consumed daily before the ADI value was reached.

3.7 continued

v144 PETUKHOV, R.D. (1981) [Determination of Kelthane in honey by thin-layer chromatography.] Byulleten' Vsesoyuznogo Instituta Eksperimental'noĭ Veterinarii 41 : 74-76 [Ru, B, AA617/85]

Kelthane (dicofol) may contaminate honey by being present in the nectar of bee plants sprayed with the pesticide, or more directly as a result of its use against Varroa.

For chromatography a 30-g sample of honey is mixed with 5 g anhydrous sodium sulphate and extracted 3 times with 40 ml hexane for 10 min. The hexane is then evaporated on a water bath at 60°C. A chromatogram of the residue is run with a mixture of hexane and benzol and examined under UV light. Dicofol displays a blue-green colour.

RITTER, W. (1980) Versuche mit Kelthane am Institut Oberursel.

The full entry, with annotation, is in 3.63. (Honey from 7 colonies treated 3 times with Kelthane (during the flow) was analysed; the samples contained from 0.2 to 0.7 ppm of Kelthane.)

RITTER, W.; RUTTNER, F. (1980) Neue Wege in der Behandlung der Varroatose. Ameisensäure. Labor- und Freilandversuche.

The full entry, with annotation, is in 3.66. (Of 6 honey samples from treated colonies, formic acid was not detectable in 2; in 2 others the allowed limit of 40 ppm was exceeded (47 and 64 ppm).)

RUTTNER, F.; RITTER, W.; GÖTZ, W. (1980) Chemotherapie der Varroatose über die Haemolymphe der Biene.

The full entry, with annotation, is in 3.62. (Analysis of honey samples from treated colonies showed levels of K-79 at or below the detectable limit of 0.01 ppm.)

SANTAS, L.A.; EMMANOUEL, N.G.; PAPADOPOULOU-BATZAKI, D.G. (1981) Preliminary observations from the use of two control methods for Varroa disease in Greece.

The full entry, with annotation, is in 3.69. (No malathion residues were found in honey.)

v145 STOYA, W.-G. (1985) Methansäurerückstände im Bienenhonig nach Behandlung der Bienenvölker mit dieser Säure im Rahmen der Varroatose-Bekämpfung. [Formic acid residues in honey after treatment of honeybee colonies to control varroa disease.] Apidologie 16(3) : 216-217 [De, B]

Colonies were treated in one of two ways: (a) rapid evaporation of 23 ml formic acid (65%), repeated 3 times at 4-day intervals, or (b) continuous slow evaporation of formic acid (98%) for 21 days. Honey and sugar syrup fed for wintering were checked for residues of formic acid before and immediately after treatment, and at regular intervals up to 31-40 weeks after treatment. The consistency, appearance, aroma and flavour of all honeys were also recorded. Formic acid levels in honey were high at first, but decreased to naturally occurring values (100 mg/kg).

Provided the colonies were treated during late autumn, no waiting period has to be observed, but neither method should be used during the honey flow because of the potential contamination of honey.

v146 WACHENDÖRFER, G. (AND 5 OTHERS) (1985) Neuere Erkenntnisse zur Chemotherapie der Varroatose.

The full entry, with annotation, is in 3.66. (To avoid formic acid residues in honey, autumn treatment is recommended.)

3.8 LEGISLATION

BLECH, K. (1979) Die neue Bienenseuchen Verordnung. [The new honeybee disease regulation.] Imkerfreund 34(6) : 186-187 [De, B]

For control of *V. jacobsoni* infestations.

COUSTON, R. (1980) The case for banning imports of bees to the United Kingdom and Eire. Scottish Beekeeper 10 : 150-152 [En, B]

ENGLERT, K. (1982) Ist eine Wirtschaftliche Bienenhaltung bei der heutigen Gesetzbegung noch möglich? [Is efficient beekeeping still possible with the present legislation?] Biene 118(3) : 108-111 [De, B]

FRANCE. LAWS AND STATUTES (1977) La varroase maladie reconnue légalement contagieuse. [*Varroa* disease recognized legally as contagious.] Abeilles et Fleurs No. 274 : 2 [Fr, B, AA235L/79]

Extract from Journal Officiel, 8 April 1977, modifying the certificate which must accompany consignments of bees addressed to France.

FRILLI, F. (1980) Provvedimenti per la profilassi della varroasi nel Friuli-Venezia Giulia). [Provisions for the prophylaxis of *V. jacobsoni* infestations (of honeybees) in the Friuli-Venezia Giulia area (Italy, legislation).] L'Apicoltore Moderno 71(5) : 179-183 [It, B]

KSHIRSAGAR, K.K.; SURYANARAYANA, M.C.; THAKAR, C.V. (1981) Import of exotic bees (*Apis mellifera*) amnd quarantine facilities. Indian Bee Journal 43(2) : 31-36 [En, B]

ITALY. LAWS AND STATUTES (1978) Ordinanza ministeriale 31 Marzo 1978. Norme per l'importazione dall'estero di api vive e di covata di api ai fini della prevenzione della varroasi. [Ministerial ordinance 31 March 1978. Rules for the importation of foreign live bees and of bee brood, for the prevention of varroa disease.] Apicoltore Moderno 69(3) : 93-95 [It, B, AA892L/79]

MAREK, J. (1980) Veterinarni předpisy ve vztahu k Varrooze. [Veterinary regulations in relation to *V. jacobsoni* infestations.] Včelařství 33(12) : 273-274 [Cs, B]

Czechoslovakia.

MAUTZ, D. (1982) Bienenseuchen-Verordnung. [Honeybee disease decree.] Imkerfreund 37(11) : 432-433 [De, B]

Legislation for control of *V. jacobsoni* infestations, West Germany.

MAVER, S. (1982) Predpisi naj bi upoštévali razm ere. [Regulations should follow the circumstances.] Slovenski Čebelar 84(4) : 107-111 [Sn, B]

Control of *V. jacobsoni* infestations of honeybees, Yugoslavia.

PCHELOVODSTVO (1980) [Regulations for the prophylaxis and control of *V. jacobsoni* infestations of honeybees.] Pchelovodstvo No. 7 : 14-16 [Ru, B]

ROSENBERG, O. (1980) Dronningimport og varroamidd. [Honeybee queen imports and varroa mites.] Birøkteren 96(6) : 113-114, 135 [No, B]

Scandinavia.

3.8 continued

TROPPER, A. (1980) Gesetzliche Grundlagen für die Varroabekämpfung. [Legal bases for control of Varroa jacobsoni infestations.] Bienenvater 101(11) : 303-304 [De, B]
Austria.

UNITED KINGDOM. LAWS AND STATUTES (1978) The importation of bees order 1978. Statutory Instrument No. 683 : 4 pp. [En, B, AA514L/79]
Bees imported into the UK must now (after 1 July 1978) be certified free of V. jacobsoni.

USSR. MINISTRY OF AGRICULTURE (1980) [Regulations on prevention and treatment of varroa disease.] Pchelovodstvo No. 7 : 14-16 [Ru, E1565, B, AA1023L/81]

VESELY, V. (1982) Podmínky dodavek matek, oddělků a smetenců v roce 1982. [Conditions for delivery of queens, nuclei and artificial swarms in 1982.] Včelařství 35(5) : 98-99 [Cs, B]
Czechoslovakia.

VILLUMSTAD, E. (1981) Reinvalsområder, reinavl og dronningimport. [Pure-line breeding areas, pure-line breeding and queen imports.] Birøkteren 97(4) : 78-79 [No, B]
Norway.

4 OTHER HONEYBEE MITES

4.1 EXTERNAL ACARAPIS

BRIMBLECOMBE, A.R.; ROFF, C. (1960) Mites associated with honeybees in Queensland. Queensland Journal of Agricultural Science 17(4) : 447-448 [En, B, AA483/62]

In a rapid survey, Acarapis mites were found on the thorax of worker honeybees in several widely spaced apiaries. The distribution is probably general in Queensland. No mites have been found in the tracheae.

CLINCH, P.G.; ROSS, J.G.M. (1970) External acarine mites, Acarapis spp. (Acarina : Trombidiformes) on honey bees in New Zealand. New Zealand Entomologist 4(3) : 136-137 [En, B, AA432/71]

Three species of external acarine mite have been recorded on honeybees in both islands of New Zealand: Acarapis externus, A. dorsalis and A. vagans.

CLINCH, P.G. (1971) Examination of bees from Tonga reveals a new ascid mite. New Zealand Beekeeper 33(4) : 4-6 [En, B, AA1013/72]

A limited survey in Tonga for disease in honeybee colonies and swarms showed the presence of Acarapis externus, A. dorsalis, A. vagans and Nosema apis.

DELFINADO-BAKER, M.; BAKER, E.W. (1982) Notes on honey bee mites of the genus Acarapis Hirst (Acari: Tarsonemidae). International Journal of Acarology 8(4) : 211-226 [En, B, AA1284/83]

A. woodi, A. dorsalis and A. externus are redescribed and illustrated in detail; their morphology and biology, and their distribution, are reviewed and discussed. Species may be identified by morphological as well as biological characteristics; a key to the identification of females is given. A. woodi is restricted to the prothoracic tracheae of the adult hosts (Apis mellifera and Apis cerana). A. dorsalis and A. externus are found externally on Apis mellifera, the former in the dorsal groove between the mesoscutum and mesoscutellum, the latter on the membranous area between the posterior region of the head and thorax and in the posterior tentorial pits. A. vagans is relegated to a nomen dubium.

DELFINADO-BAKER, M.; STYER, W.E. (1983) Mites of honeybees as seen by scanning electron microscope (SEM) American Bee Journal 123(11) : 812-813, 819 [En, B, AA247/85]

Includes 10 photographs of 5 mite species, and a table listing these species and 4 others; for each, the distribution and the host Apis species are given and also the part of the colony or comb where it is found.

GIORDANI, G. (1962) Recherches au laboratoire sur Acarapis woodi Rennie, agent de l'acariose des abeilles (Apis mellifera L.) Note 1.

The full entry, with annotation, is in 2.33.

GIORDANI, G. (1963) Ricerche di laboratorio su Acarapis woodi Rennie, agente della acariosi delle api (Apis mellifera L.) Nota 2.

The full entry, with annotation, is in 2.33.

4.1 continued

GROBOV, O.F.; SKRYPNIK, E.I.; KORDONSKII, E.I. (1968) [The mite fauna of honeybee colonies.] Veterinariya (7) : 59-60 [Ru, B, AA463/72]

Investigations detected the presence of other species of mites in colonies which were infested or uninfested with acarine mites, but infestation was lower in some of the colonies as a result of treatment with acaricides.

Members of the Tyroglyphidae, which feed chiefly on organic detritus, were present. The "external mites" Acarapis externus, A. dorsalis and A. vagans were not found. The mite fauna of the soil surrounding the hives was similar to that in the bottom of hives.

LANGRIDGE, D.F. (1963) Acarapis mites in Victoria. Beekeepers' Bulletin 8(1) : 7-8 [En, B, AA165L/64]

Gives locations of external Acarapis spp. in Victoria.

MORGENTHALER, O. (1934) Krankheitserregende und harmlose Arten der Bienenmilbe Acarapis, zugleich ein Beitrag zum Species-Problem. [Pathogenic and harmless species of the bee-mite Acarapis and a contribution to the species problem. Revue Suisse de Zoologie 41(29) : 429-446 [De, B]

SCHNEIDER, H. (1941) Untersuchungen über die Acarapis-Milben der Honigbiene. Die Flügel- und Hinterleibsmilbe. [Investigation on the acarine mites of the honeybee. The wing- and abdomen-mites.] Mitteilungen der Schweizerischen Entomologischen Gesellschaft 18(6) : 318-327 [De, B]

Describes the positions on the bee in which A. dorsalis, A. externus and A. vagans, and also A. woodi were found. Some morphological data are compared. This is the first naming of A. vagans.

SCHNEIDER, H. (1960) Problemes biologiques de l'Acarapis des abeilles.
The full entry, with annotation, is in 2.33.

4.11 ACARAPIS DORSALIS

BRÜGGER, A. (1936) Zur Kenntnis der äusserlichen Acarapis-Milben. [Information on external Acarapis mites.] Archiv für Bienenkunde 17(4/5) : 113-142 [De, E454, B]

Reviewed in Bee World 17(7) : 80 (1936); A. dorsalis and A. externus.

CHANEET, G. DE; KESSELL, A.C.; ALLEN, L.F. (1984) Acarapis mites on honeybees. Australian Veterinary Journal 61(10) : 322-323 [En, B, AA618/86]

In an examination of a total of 400 bees from 21 apiaries in south-west Western Australia in 1979, Acarapis mites were found on 37 bees from 13 apiaries; they were identified as A. dorsalis and A. externus.

CLINCH, P.G. (1976) Observations on the seasonal incidence of external mites Acarapis spp. on honey bees. New Zealand Journal of Experimental Agriculture 4 : 257-258 [En, B, AA1301/77]

Samples of honeybees taken from colonies at approximately monthly intervals were examined for external mites. Of all bees examined, 41.5% were infested with mites, 39.1% with Acarapis externus, 5.6% with A. dorsalis, and 3.2% with both. Mite populations were highest in autumn and spring, and lowest in summer.

4.11 continued

CLINCH, P.G. (1979) *Nosema apis* and mites in honeybee colonies in Papua New Guinea. Journal of Apicultural Research 18(4) : 298-301 [En, B, AA238/81]
Colonies of *Apis mellifera* in a beekeeping project were surveyed in Nov. 1977. Approximately 30 000 bees from 424 colonies were screened for mites, and *Acarapis externus*, *A. dorsalis* and *Neocypholaelaps africana* were identified; none had previously been recorded in Papua New Guinea.

ECKERT, J.E (1961) *Acarapis* mites of the honey bee, *Apis mellifera* L.
The full entry, with annotation, is in 2.21.

LUNDER, R. (1936) Sind die Aussenmilben der Bienen gang harmlos? [Are the external mites of honeybees harmless?] Schweizerische Bienen-Zeitung 59(4) : 210-211 [De, B]
Reviewed in Bee World 17(9) : 104 (1936); *A. dorsalis* and *A. externus* in Norway, but not *A. woodi*.

MICHAEL, A.S. (1962) Morphological characters of the honey bee mites.
The full entry, with annotation, is in 2.32.

SCHNEIDER, H. (1939) Neues von den Bienenmilben. [The latest about bee mites.] Schweizerishe Bienen-Zeitung 62(6a) : 336-338, 372-373 [De, B]
Reviewed in Bee World 20(12) : 142 (1939); *A. dorsalis* was found in the scutellar groove and second abdominal segment (breeding there). These bees were in a colony with no *A. woodi*.

4.12 *ACARAPIS EXTERNUS*

BORCHERT, A. (1934) On the breeding-places of the external mite (*Acarapis*) on the honeybee. Bee World 15(4) : 43-44 [En, B]

BRIMBLECOMBE, A.R.; ROFF, C. (1961) Distribution of *Acarapis woodi* (Rennie).
The full entry, with annotation, is in 2.21.

BRÜGGER, A. (1936) Zur Kenntnis der äusserlichen Acarapis-Milben.
The full entry, with annotation, is in 4.11.

CHANEET, G. DE; KESSELL, A.C.; ALLEN, L.F. (1984) *Acarapis* mites on honeybees.
The full entry, with annotation, is in 4.11.

CLINCH, P.G. (1976) Observations on the seasonal incidence of external mites *Acarapis* spp. on honey bees. New Zealand Journal of Experimental Agriculture 4 : 257-258 [En, B, AA1301/77]
The full entry, with annotation, is in 4.11.

CLINCH, P.G.; FAULKE, J. (1977) Toxicity to the external mite *Acarapis externus* Morgenthaler of pesticides fed in sugar syrup to infested honey bees. New Zealand Journal of Experimental Agriculture 5 : 185-187 [En, B, AA947/78]
In laboratory tests, endosulfan was the most effective of 23 compounds, each of which was fed in sugar syrup to groups of workers from a colony

4.12 continued

heavily infested with *A. externus*. Field tests on 3 colonies confirmed these results.
A single dose of 40 mg of endosulfan in 2 litres of sugar syrup reduced the percentage of bees infested in a colony from 61% to 9%; a second dose 19 days later reduced the level to 1%. Only a few more adult bees died in treated colonies than in untreated ones.
The pesticides tested appeared to act systemically through the bee; thus the method could probably be used to control the internal mite, *A. woodi*.

CLINCH, P.G. (1979) Control of *Acarapis externus* Morgenthaler: further tests to determine the efficacy of pesticides fed in sugar syrup to infested honey bees. New Zealand Journal of Experimental Agriculture 7 : 407-409 [En, B, AA243/81]
Laboratory and field studies were carried out to determine the effect of 16 pesticides fed in sugar syrup to honeybees infested with *Acarapis externus*. All organophosphorus and carbamate insecticides tested were ineffective. The four compounds most effective in laboratory tests were fed to colonies of bees. In one trial, fenbutatin oxide was significantly more effective than endosulfan in reducing infestations. In another trial, amitraz and tricyclohexyltin hydroxide were both significantly more effective than endosulfan in reducing mite populations and the number of bees infested. Amitraz, at the concentration tested, killed many adult bees, whereas the other 3 compounds killed few or none.

CLINCH, P.G. (1979) *Nosema apis* and mites in honeybee colonies in Papua New Guinea.
The full entry, with annotation, is in 4.11.

ECKERT, J.E. (1961) Observations on the *Acarapis* mites of honey bees.
The full entry, with annotation, is in 2.21.

ECKERT, J.E. (1961) *Acarapis* mites of the honey bee, *Apis mellifera* L.
The full entry, with annotation, is in 2.21.

FOOTE, H.L. (1959) Acarine mite reported in U.S.
The full entry, with annotation, is in 2.21.

FREUDENSTEIN, K. (1933) Zur Frage der Identität der harmlos und seuchenerregend in Bienenstöcken vorkommenden "Bienenmilben" (*Acarapis woodi*, Rennie und *Acarapis externus*, Morgenthaler).
The full entry, with annotation, is in 2.13.

HOMANN, H. (1934) Die Milben in gesunden Bienenstöcken. [Mites in healthy honeybee colonies.] Parasitenkunde 6(3) : 351-415 [De, B]
Reviewed in Bee World 15(5) : 59-60 (1934); includes *Acarapis externus*.

LUNDER, R. (1936) Sind die Aussenmilben der Bienen gang harmlos?
The full entry, with annotation, is in 4.11.

MICHAEL, A.S. (1962) Morphological characters of the honey bee mites.
The full entry, with annotation, is in 2.32.

MORGENTHALER, O. (1933) Von der "äusserlichen" Bienenmilbe. [The external bee mite.] Schweizerische Bienen-Zeitung 56(12) : 619-621 [De, B]
Translation in Bee World 15(1) : 5-6 (1934).

4.12 continued

MORGENTHALER, O. (1938) Bienenkrankheiten im Jahre 1937. [Bee diseases in 1937.] Schweizerische Bienen-Zeitung 61(6a) : 390-396 [De, B]
Brügger states that *A. externus* resisted Frow treatment better than *A. woodi*.

MORGENTHALER, O. (1960) Neuere Arbeiten über das Vorkommen der Bienenmilbe *Acarapis*.
The full entry, with annotation, is in 2.21.

MORISON, G.D. (1931) An *Acarapis* living externally in the honey-bee. Bee World 12(9) : 110-111 [En, B]
A. externus.

ÖRÖSI-PÁL, Z. (1934) Bau, Entwicklung und Lebensweise des Bienenparasiten *Acarapis woodi* (Acarana). [Structure, development and habits of bee parasite *Acarapis woodi*.] Zeitschrift für Parasitenkunde 7(2) : 233-267 [De, B]
Reviewed in Bee World 16(4) : 44 (1935); contains some information on *A. externus*.

ÖRÖSI-PÁL, Z. (1935) Die äusserlichen Acarapismilben in Oesterreich. [External acarine mites in Austria.] Bienen-Vater 67(12) : 422-424 [De, B]
Reviewed in Bee World 17(3) : 33-34 (1936); *A. externus*.

ÖRÖSI-PÁL, Z. (1938) Der Brutplatz der Ararapismilben auf dem Hinterleib der Honigbiene.
The full entry, with annotation, is in 2.42.

SHAW, F.R.; FISCHANG, W.J.; BALBONI, E.R.; EVERSOLE, J.W. (1961) External mites on honeybees in U.S. Gleanings in Bee Culture 89(7) : 402-403, 447 [En, B, AA639/63]
External *Acarapis* mites have been found on bees from all New England States (USA). Preliminary data indicate that their incidence decreases in the autumn, increases in spring, and is highest in late spring and summer; it is higher on young worker bees than on older ones. In 85% of the colonies examined, infestation was below 20%. Mite infestation does not appear to affect normal activity.

4.13 ACARAPIS VAGANS

See the following entries in 4.1:
CLINCH, P.G.; ROSS, J.G.M. (1970)
CLINCH, P.G. (1971)
DELFINADO-BAKER, M.; BAKER, E.W. (1982)
GROBOV, O.F., ET AL. (1968)
SCHNEIDER, H. (1941)

4.2 ACEOSEJUS SP.

SEVILLA, V.J. (1963) Observations on the life history and habits of three new acarine pests of honeybees in the Philippines. BSc Thesis, University of the Philippines : 42 pp. [En, B, AA572/68]

Three species of mite (*Tropilaelaps clareae*, *Varroa jacobsoni* and *Aceosejus* sp.) are reported here for the first time as pests of honeybees (*Apis mellifera*) in the Philippines. Adult mites of the genus *Aceosejus* (*Aceosejidae*) were found on adult *Apis mellifera* for a short period. The male and female mites are described, but their life history and any effects on the bees were not determined. Mite infestation was manifested by reduced worker bee population, preponderance of abnormal bees with mutilated wings, irregularity of pattern of sealed brood cells, and tendency of the bees to swarm. Graphs and tables give details of infestation of colonies by one or more species of mite, and show seasonal cycles of infestation. *Apis cerana* (drones only) were found infested with *V. jacobsoni*, but not with *T. clareae*.

4.3 EUVARROA SINHAI

AKRATANAKUL, P.; BURGETT, M. (1976) Euvarroa sinhai Delfinado and Baker (Acarina: Mesostigmata): a parasitic mite of Apis florea. Journal of Apicultural Research 15(1) : 11-13 [En, B, AA727/76]

The biology of this mite was investigated. It is a parasite of drone brood of Apis florea. The developmental stages are egg, protonymph, deutonymph and sexual adult. This mite is reported for the first time from Thailand.

AKRATANAKUL, P. (1976) Biology and systematics of bee mites of the family Varroidae (Acari: Mesostigmata). MS Thesis, Oregon State University, Corvallis, USA : x + 64 pp. [En, B, AA625/77]

The mites are reported for the first time in Thailand. The life cycles of both mites are similar and are here reported in detail. The systematics of the family Varroidae are reviewed, and some new taxonomic descriptions are presented for E. sinhai, with additional data for V. jacobsoni.

DE JONG, D.; MORSE, R.A. (1979) Annotated bibliography on Varroa jacobsoni, Tropilaelaps clareae and Euvarroa sinhai. Bibliography, International Bee Research Association No. 15 : 36 pp. [En, B, AA1352L/80]

Revision of 1976 ed. with 249 additional references.

KOENIGER, N.; KOENIGER, G.; DELFINADO-BAKER, M. (1983) Observations on mites of the Asian honeybee species (Apis cerana, Apis dorsata, Apis florea). Apidologie 14(3) : 197-204 [En, de, fr, B, AA439/85]

Euvarroa sinhai was found in low numbers in all Apis florea colonies examined (first report for Sri Lanka); Tropilaelaps koenigerum was present in 5 of 6 Apis dorsata colonies. Neocypholaelaps indica (a pollen feeder) was found in colonies of all 3 Apis species; it has not previously been recorded on Apis dorsata and Apis florea.

4.4 MACROCHELES SPP.

VOBRÁZKOVÁ, E.; SAMŠIŇÁK, K.; HARAGSIM, O. (1978) O roztočích z rodu Macrocheles. [Mites of the genus Macrocheles.] Včelařství 31(7) : 154 [Cs, B, AA260/80]

In Czechoslovakia M. glaber has been identified on 13% of honeybee samples examined, and M. muscaedomisticae on 5%. They are large brown mites, the females having a body length 0.7-0.9 mm, with long legs, which help to distinguish them from Varroa jacobsoni. They do not seem to be very harmful in colonies.

4.5 MELLITIPHIS ALVEARIUS

COOK, V.A.; BOWMAN, C.E. (1983) Mellitiphis alvearius, a little-known mite of the honeybee colony, found on New Zealand bees imported into England. Bee World 64(2) : 62-64 [En, B, AA281L/84]

On attendant workers accompanying queens imported in April and May, 1982.

DAVYDOVA, M.S. (1976) [The gamasid mite Mellitiphis alvearius - parasite and commensal of the honeybee.] Pages 183-190 from "Novosti fauny sibiri" ed. A.I. Cherepanov [Ru, en, B, AA688/79]

The male, female, protonymph and deutonymph of this mite are described, with figures. The author names the mite as Mellitiphis alvearius Berlese, 1896 (Tropilaelaps clareae Delf. et Baker, 1964). Comparing his drawings with those of Delfinado and Baker, they differ in several respects from those for T. clareae but closely resemble those for M. alvearius.

EMMANOUEL, N.G..; PELEKASSIS, C.D.; SANTAS, L.A. (1983) Harmful mesostigmatic mites ectoparasitic to honey bees. Entomologia Hellenica 1 : 17-23 [En, B]

Mites of the order Mesostigmata are among the frequent and dominant components of the beehive acarofauna. Several of them belonging to the families: Varroidae, Laelapidae and Ameroseiidae are important parasites or capably harmful species to the honeybee. Among them, V. jacobsoni and Neocypholaelaps favus are widespread in Greece, while the existence of a third species Mellitiphis alvearius is quite probable. A brief treatise of the harmful mesostigmatic mites found in the beehives all over the world is given. Detailed drawings of all stages of V. jacobsoni are given; those of the immature stages appear for the first time.

4.6 PYEMOTES SPP.

DINABANDHOO, C.L.; DOGRA, G.S. (1980) Incidence and control of ectoparasitic mite, *Pyemotes herfsi* Ondenmans [sic] of the Indian honey bee, *Apis cerana* Fab. American Bee Journal 120(1) : 44, 46-47 [En, B, AA810L/81]

In 1978 two *Apis cerana* colonies in the Kulu Valley, Himachal Pradesh, India, showed symptoms different from those of acarine disease. An ectoparasitic mite found on bees from the colonies was identified as *Pyemotes herfsi* Ondemans (*Pyemotes ventricosus* New Port 1840 sensu Houghes, 1961). The mite is described. It attacks the mouthparts of the bee, and a single mite can destroy the function of the mouth. Some mites were found feeding on the intersegmental sclerites. *P. herfsi* infestation was controlled by fumigating a colony 3 times with dichlorvos.

LAERE, O. VAN; DAELE, E. VAN (1981) Infection of bee colonies caused by acarine mites of Pymotes genus. Apiacta 16(3) : 101-106 [En, B, AA587L/82]

Identified in a sample of honeybee brood from Chile.

TOMASZEWSKA, B.; ZAHACZEWSKA, M. (1973) Niektóre gatunki roztoczy występujace u pszczół i w środowisku ulowym oraz ich zwalczanie. [Some species of mite occurring in bees and in the hive, and their control.] Pszczelarstwo 24(1) : 3-4 [Pl, B, AA768L/74]

Mentions mites in bee larvae including *Pyemotes tritici*.

4.7 TROPILAELAPS SPP.

4.71 TROPILAELAPS CLAREAE

ATWAL, A.S. (1969) Serious infestation of Apis mellifera L. bees by the ectoparasitic mite Tropilaelaps clareae. Summaries, XXII International Beekeeping Congress : 108 [En, De, Fr, B, AA467/70]

ATWAL, A.S.; GOYAL, N.P. (1971) Infestation of honeybee colonies with Tropilaelaps, and its control. Journal of Apicultural Research 10(3) : 137-142 [En, B, AA1042/72]

In a serious attack of the mite T. clareae on Apis mellifera colonies at Ludhiana, India, up to 50% of the brood was killed in the late larval and pupal stages, and colony populations dwindled rapidly. Preliminary observations are given on the biology of the mite. Honeybee larvae are killed by the nymphs feeding on them, or (if attacked later) they develop into deformed adults which are evicted from the hive. A badly infested colony is left with practically no brood, and it may abscond ultimately, the bees carrying the adult mites with them. (After the mites have transformed into adults they remain just under the cell cappings, and are exposed when these are removed.) Terramycin and fumigations with chlorobenzilate did not give effective control, but a light dusting with sulphur every month controlled infestations completely.

BHARADWAJ, R.K. (1968) A new record of the mite Tropilaelaps clareae from Apis dorsata colonies. Bee World 49(3) : 115 [En, B, AA846/70]

Specimens of T. clareae were collected from a colony of Apis dorsata killed for study at New Delhi, India, on 4 May 1967. Mites were collected also from two additional colonies where they were associated with immature forms of the bee. No immature stages of the mite were found.

BURGETT, M.; AKRATANAKUL, P.; MORSE, R.A. (1983) Tropilaelaps clareae: a parasite of honeybees in south-east Asia. Bee World 64(1) : 25-28 [En, B, AA975/83]

The authors consider the current status of T. clareae and suggest that it could become as serious a pest to world beekeeping as Varroa jacobsoni. Details are given of known distribution, life cycle, mode of parasitism (very similar to V. jacobsoni), and attempts, largely unsuccessful, to control infestations with various chemicals.

BURGETT, D.M.; KRANTZ, G.W. (1984) The future of the European honey bee (Apis mellifera L.) in southeast Asia: constraints of parasitism. Pages 34-43 from "Proceedings of the Expert Consultation on Beekeeping with Apis mellifera in Tropical and Sub-tropical Asia, Bangkok/Chiang Mai, Thailand, 9-14 April 1984", Rome : FAO [En, B]

Deals mainly with V. jacobsoni and T. clareae.

DAVYDOVA, M.S. (1976) [The gamasid mite Mellitiphis alvearius - parasite and commensal of the honeybee.]

The full entry, with annotation, is in 4.5

DE JONG, D.; MORSE, R.A. (1980) Annotated bibliography on Varroa jacobsoni, Tropilaelaps clareae and Euvarroa sinhai.

The full entry, with annotation, is in 4.3.

4.71 continued

DELFINADO, M.D.; BAKER, E.W. (1961) *Tropilaelaps*, a new genus of mite from the Philippines (Laelaptidae (s. lat.): Acarina). Fieldiana, Zoology 44(7) : 53-56 [En, B, AA866/63]

The authors give a detailed taxonomic description, with 9 drawings, of a comparatively large mite *T. clareae* n.sp., for which they erect a new genus. The mites were first found in a collection of dead honeybees at Mataasna-Kahoy, Lipa. Later they were found on field rats nesting near the hives.

DELFINADO, M.D. (1963) Mites of the honeybee in south-east Asia. Journal of Apicultural Research 2(2) : 113-114 [En, B, AA636/64]

Reports are given on *T. clareae* and *V. jacobsoni*. *T. clareae* has been found in the Philippines on adult *Apis mellifera* as well as on larvae and pupae.

DELFINADO-BAKER, M. (1982) New records for *Tropilaelaps clareae* from colonies of *Apis cerana indica*. American Bee Journal 122(5) : 382 [En, B, AA420L/83]

The samples came from Burma and Pakistan.

GLIŃSKI, Z.; CHMIELEWSKI, M. (1984) *Tropilaelaps clareae* - zagrozenie dla gospodarki pasiecznej. [*Tropilaelaps clareae* - a threat to the livelihood of beekeepers.] Medycyna Weterynaryjna 40(1) : 41-44 [Pl, B, AA251L/85]

Review.

GROBOV, O.F.; IVANOV, YU. A.; POPOV, E.T. (1981) [*Tropilaelaps clareae* infestations of honeybees.] Pchelovodstvo No. 10 : 18-19 [Ru, E1589, B, AA1285/83]

The author describes briefly the morphology, biology and distribution of this mite, and gives a method for diagnosing its presence in a colony. No satisfactory control method has yet been found, and it is recommended that a system of regular colony inspection be set up in threatened zones in order to prevent the introduction of *T. clareae* into the USSR.

GROBOV, O.F.; IVANOV, YU. A.; POPOV, E.T.; STOLBOV, N.M. (1983) [*Tropilaelaps clareae* infestations of honeybees.] Veterinariya, Moscow, USSR No. 5 : 46-48 [Ru, B, AA1282/84]

The habits and life history of *T. clareae* are compared with those of *V. jacobsoni*. The danger of its introduction to the USSR is discussed.

KITPRASERT, C. (1984) [Biology and systematics of the parasitic bee mite, *Tropilaelaps clareae* Delfinado and Baker (Acarina: Laelapidae) MSc Thesis, Kasetsart University, Thailand : xi + 70 pp. [Thai, en, B, AA1341/85]

Since the description of *T. clareae* in 1961, only the adult male and female have been known. The present study describes for the first time all developmental stages of *T. clareae*: egg, larva, protonymph, deutonymph and both sexes of the adult mite. The life cycle of the mite was also investigated. Female mites entered brood cells 7-9 days old, and laid eggs which were either attached to the wall of the cell or to the body of the developing bee. The developmental periods of the mite's successive stadia were: egg 1.05 ± 0.15 days, larva 1.85 ± 0.36 days, protonymph 2.11 ± 0.33 days and deutonymph 3.75 ± 0.50 days. The larvae and nymphs feed on the blood of the immature bee. When adult females were allowed to feed on honeybee pupae the average lifespan of the mites was 28.53 ± 1.36 days. When the mites fed on adult workers they lived

4.71 continued

for 2.70 ± 0.47 days. When no hosts were provided the parasite's life-span was 1.40 ± 0.50 days. Observations on the numbers and frequency of T. clareae in honeybee brood cells, and on the synchronization of the development of the parasite and that of the host are also described.

KOIVULEHTO, K. (1980) Tropilaelaps clareae - another mite threatening world beekeeping. British Bee Journal 108(4418) : 197-199 [En, B, AA642L/81]

KSHIRSAGAR, K.K. (1982) Current incidence of honeybee diseases and parasites in India.
The full entry, with annotation, is in 2.21.

LAIGO, F.M.; MORSE, R.A. (1968) The mite Tropilaelaps clareae in Apis dorsata colonies in the Philippines. Bee World 49(3) : 116-118 [En, B, AA847/70]
The mite was found in 7 of the 8 Apis dorsata colonies examined. Infested colonies had irregular brood patterns, some dead pupae, and adult bees with damaged wings. Some infested colonies also had heavy infestations of wax moth (Galleria mellonella) and, in some cases, large quantities of dead brood.

LAIGO, F.M.; MORSE, R.A. (1969) Control of the bee mites, Varroa jacobsoni Oudemans and Tropilaelaps clareae Delfinado and Baker with chlorobenzilate. Philippine Entomologist 1(2) : 144-148 [En, B, AA434/71]
Brood nests of Apis mellifera infested with V. jacobsoni were treated with one of two formulations of chlorobenzilate. Results are not given for T. clareae because the incidence of infestation was low.
It is recommended that colonies should be treated 3 times at weekly intervals, and that each series of treatments should be repeated every 2-3 months.

MAUNG MAUNG NYEIN; ZMARLICKI, C. (1982) Control of mites in European bees in Burma. American Bee Journal 122(9) : 638-639 [En, B, AA275/84]
In Burma the native host of V. jacobsoni is Apis cerana, and that of T. clareae is Apis dorsata. Both mites were also found in all mature Apis mellifera colonies examined. A treatment programme for 21 Apis mellifera colonies involved: confinement of the queen in a cage for 21 days; uncapping of dead brood; feeding with sugar syrup (which stimulated hive cleaning); fumigation with phenothiazine. Six colonies which suffered queen failure during the following 7 months were lost, but in the other 15 colonies the populations of both mites were reduced. After release the queens began to lay rapidly, and all 15 colonies increased and produced surplus honey (average 35 kg). The best time to carry out such an annual treatment is when brood rearing is at its lowest level.

MAUNG MAUNG NYEIN (1984) Notes on Apis dorsata and Tropilaelaps clareae in Burma. American Bee Journal 124(7) : 504-505 [En, B, AA810L/85]

SEVILLA, V.J. (1963) Observations on the life history and habits of three new acarine pests of honeybees in the Philippines.
The full entry, with annotation, is in 4.2

4.71 continued

STEPHEN, W.A. (1968) Mites: a beekeeping problem in Vietnam and India. Bee World 49(3) : 119-120 [En, B, AA990/70]

T. clareae and V. jacobsoni were collected from colonies of Apis mellifera in Vietnam. Only T. clareae was found in Apis mellifera colonies examined in India.

WOYKE, J. (1985) Methods to combat the parasitic bee mite, Tropilaelaps clareae without the use of medicine. Pages 86-87 from "XXXth International Apicultural Congress: program and abstracts report" [En, B]

Examination of brood combs of Apis dorsata showed that 30% of brood was infested with T. clareae. Brood cells of Apis mellifera were up to 86% infested in Afghanistan and up to 62% in Vietnam. Infestation of adult bees was always very low. In Afghanistan, infested colonies were those which were moved during winter to warmer areas where interruption of brood rearing did not occur. Colonies left for winter in Kabul, where interruption of brood rearing occurs for 2 months, were free of the mite by the next spring.

T. clareae mite can only survive for 2 days in the absence of honeybee brood, so control of T. clareae is possible merely by depriving bee colonies of all brood. Various methods were investigated.

WOYKE, J. (1985) Tropilaelaps clareae in Afghanistan, and control methods applicable in tropical Asia. Pages 163-166 from "Proceedings of the Third International Conference on Apiculture in Tropical Climates, Nairobi, Kenya, 5-9 November 1984", London, UK : International Bee Research Association [En, B, AA260/86]

Afghanistan is the first country outside the range of Apis dorsata in which T. clareae has caused serious damage to Apis mellifera colonies. The incidence and effect of this mite is reported. It was found that the mites were unable to survive over winter in areas such as Kabul where a cold period causes a break in the colonies' brood rearing. It therefore seems unlikely that T. clareae will cause serious damage to Apis mellifera colonies in parts of temperate regions where there is a cold spell sufficient to prevent brood rearing. Biological methods of control suitable for tropical areas were studied and any of the following are recommended: removing all brood combs from the colony (or making a broodless nucleus, for which it is not necessary to cage the queen); caging the queen for 9 days, then uncapping all sealed brood and removing as much brood as possible by shaking the combs; caging the queen for at least 21 days until all brood in the combs has emerged.

WOYKE, J. (1985) Tropilaelaps clareae, a serious pest of Apis mellifera in the tropics, but not dangerous for apiculture in temperate zones. American Bee Journal 125(7) : 497-499 [En, B, AA/86]

Evidence is provided to support the statement in the title.

4.72 TROPILAELAPS KOENIGERUM

DELFINADO-BAKER, M.; BAKER, E.W. (1982) A new species of Tropilaelaps parasitic on honey bees. American Bee Journal 122(6) : 416-417 [En, B, AA427/83]

The female, male, and protonymph of T. koenigerum n. sp. are described and illustrated. The mites were collected in brood combs of Apis dorsata in Sri Lanka. They are apparently parasitic on honeybees. T. koenigerum is compared with the species T. clareae, a pest of Apis mellifera and Apis dorsata in SE Asia.

KOENIGER, N.; KOENIGER, G.; DELFINADO-BAKER, M. (1983) Observations on mites of the Asian honeybee species (Apis cerana, Apis dorsata, Apis florea).

The full entry, with annotation, is in 4.3.

5 INDEX OF CHEMICAL AND TRADE NAMES

The index leads to entries in certain Sections: 2.6 (*Acarapis woodi*), entry numbers a1-a74, and 3.6 and 3.7 (*Varroa jacobsoni*, v1-v146). A chemical name may be followed by trade name(s) of agents based on the chemical, and/or by another chemical name . Trade names are cross-referred to the chemical name where this is known; they have a capital initial letter.

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